1710

SITE INVESTIGATION REPORT

FORMER GALT GAS COMPANY SITE

CAMBRIDGE, ONTARIO

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FORMER GALT GAS COMPANY SITE
CAMBRIDGE, ONTARIO

Report prepared for:

Waste Site Evaluation Unit
Waste Management Branch
Ontario Ministry of the Environment

Report prepared by:

Conestoga-Rovers & Associates Limited

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EXECUTIVE SUMMARY

The former Galt Gas Company Site is located within a parcel of property adjacent to the Grand River in Cambridge, Ontario. The current property owner purchased the property without knowing of the coal gasification plant which existed during the approximate period of 1886-1910. The property owner planned to re-develop the Site prior to being notified of the existence of the former coal gasification plant by the Ontario Ministry of the Environment (MOE).

The shoreline of the Grand River adjacent to the former coal gasification plant has apparently been extended outwards by filling. Currently, the Grand River Conservation Authority (GRCA) owns the property between the owner's property and the Grand River. A flood control berm is located on the GRCA property.

Several phases of investigation have been conducted. Initially, geotechnical boreholes were drilled for development purposes. These boreholes identified geologic conditions in the overburden. This work was not funded by the MOE. The investigative work conducted for the environmental investigation has included drilling 21 boreholes; chemical analysis of 16 soil samples; installation of four monitoring wells in the overburden; analysis of groundwater/fluid samples from three monitoring wells; inspection of the bottom of the Grand River adjacent to the former coal gasification plant; and analysis of water and sediment samples from the Grand River.

The geology of the Site from surface downwards includes a sand fill with gravel and rubble (up to 5 metres thick adjacent to the Grand River), an upper sequence of sands, a basal sand and gravel unit and bedrock. The bedrock is approximately 5 to 12 metres below ground surface. In some areas, thin silt layers are encountered within the overburden. A water table aquifer is found within the native sands at a depth of approximately 3.5 to 4.5 metres below ground surface. Water level measurements indicate that groundwater flow is in a southerly direction, parallel to that of the Grand River. The groundwater velocity was estimated to be approximately 1 metre/year.

The conclusions of this investigation are as follows:

1) The material underlying the former coal gasification plant includes concrete and soil containing coal tar residues. Gasoline and diesel fuel odours are also noted in this area.

2) Coal tar residues are present in soil to the west of the former coal gasification plant. These residues are found sporadically and may have been placed in part during historical filling along the edge of the Grand River.

3) Coal tar residues are present in soil beneath the GRCA flood control berm.

4) The coal tar residues are generally found in the saturated soils and represent a potential source of groundwater contamination.

5) Groundwater flow on the property appears to be approximately parallel to the Grand River and toward the south.

6) Groundwater at the southern end of the property does not exhibit contamination by PAHs. One monitoring well exhibits low concentrations of VOCs. The VOC contamination has various potential sources, including the coal tar residues and former automobile service stations in the area.

7) Coal tar residues have not migrated to the southern property boundary as evidenced by the absence of PAHs in soil and groundwater at the two monitoring wells at the boundary.

8) Coal tar residues are not visually present in the bed of the Grand River adjacent to the former coal gasification plant.

9) Water and sediment in the Grand River does not exhibit a detectable impact by PAHs from the former coal gasification plant.

The recommendations based on this investigation are as follows:

1) Any proposed disturbance of the area containing coal tar residues should be reported in writing to the MOE, Waste Management Branch prior to commencement and conducted in accordance with applicable regulations and guidelines.

2) A monitoring program should be implemented in the short term to assess the potential migration of contaminants in groundwater and surface water. This would include:

   i) measuring water levels in the monitoring wells and the Grand River quarterly for one year;

ii) collecting water samples from wells which do not contain coal tar and from two locations in the Grand River on a semi-annual basis for one year (groundwater samples would be analyzed for PAHs and VOCs, surface water samples would be analyzed for PAHs); and

iii) reporting all results to MOE.

The need for monitoring would be re-assessed at the end of the one year period.

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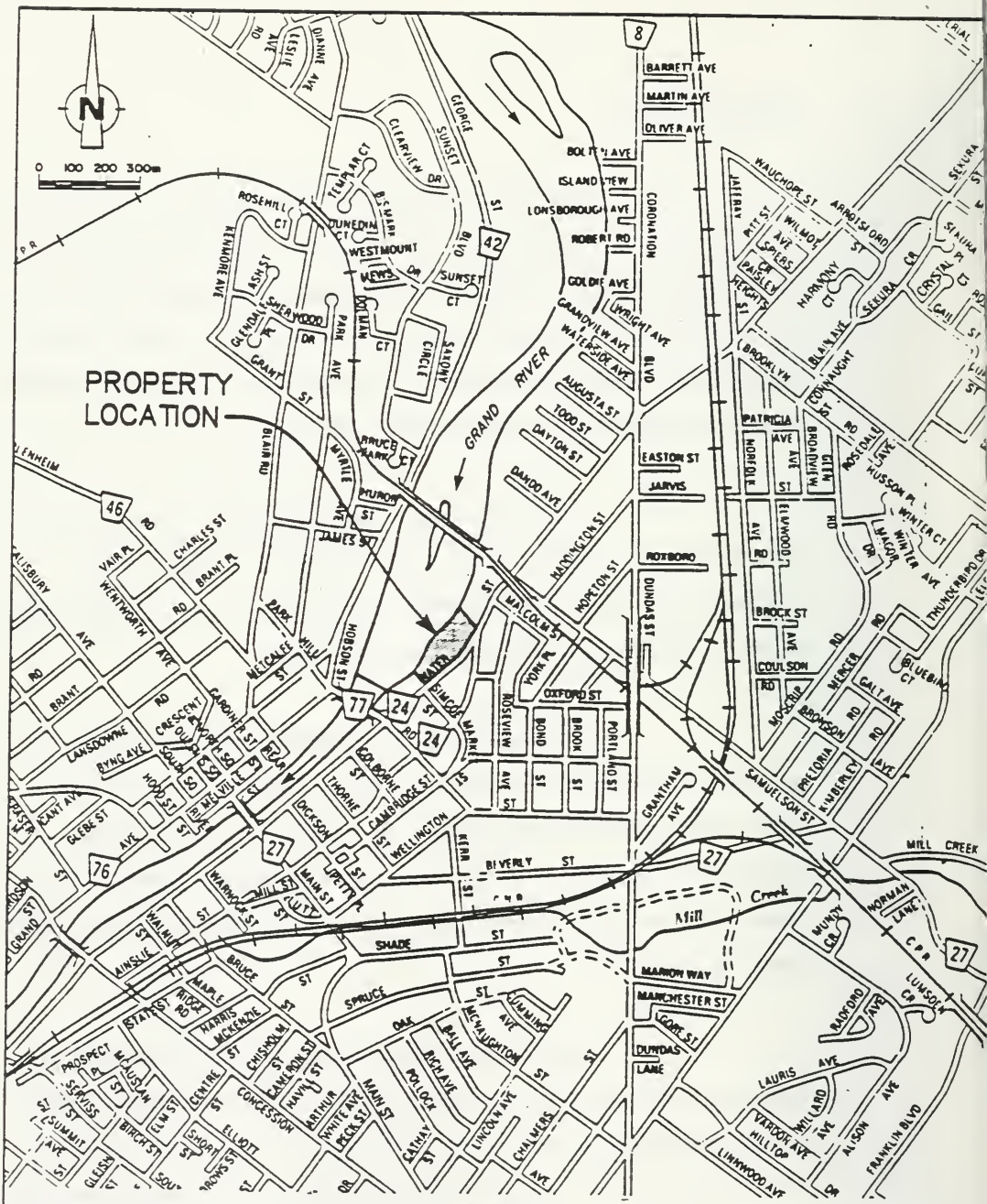
1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) has completed an investigation of coal tar contamination at the site of the former Galt Gas Co. gas works in Cambridge, Ontario. The investigation has been carried out under the terms of a cost sharing agreement between the property owner (Mill Race on the Grand, Inc.) and the Ontario Ministry of the Environment (MOE) and a proposal by CRA dated June 1989 (1).

The initial phases of the investigation were reported by CRA in September 1987 (2). This report incorporates the information contained in the September 1987 report and provides an updated assessment of site conditions utilizing all data generated to date.

The area occupied by the former coal gasification plant is part of a larger parcel which was occupied by a textile mill until the mid 1980's. This parcel is herein referred to as the Mill Race on the Grand property (the property). The current owner purchased the property without knowing of the coal gasification plant which existed during the approximate period of 1886-1910.

Figure 1.1 shows the location of the Mill Race on the Grand property, which is situated on the west side of Water Street North in the City of Cambridge, north of the Parkhill Dam. The property fronts on Water Street and backs onto the flood control berm for the Grand River. The flood control berm property is owned by the Grand River Conservation Authority (GRCA).



SOURCE: TRI-CITY MAP (KITCHENER-WATERLOO-CAMBRIDGE), REGIONAL MUNICIPALITY OF WATERLOO PLANNING DEPARTMENT, 1985.

figure 1.1

LOCATION OF MILL RACE ON THE GRAND PROPERTY

This report is organized as follows:

Section 2 contains a discussion of historical land use as originally reported in September 1987.

Section 3 contains a discussion of field investigation methods.

Section 4 contains a discussion of the geology/hydrogeology in the area investigated.

Section 5 contains a discussion of contaminant distribution in the various media examined.

Section 6 contains conclusions and recommendations.

2.0 HISTORICAL LAND USE

2.1 OPERATION OF GAS WORKS (1886-1910)

The history of the gasification plant and adjacent property was compiled through a review of documentation from the Cambridge Archives, the Cambridge Gallery and Library, the Gore-Mutual Insurance Company of Cambridge and oral communications with local residents.

The facilities present during operation of the former coal gasification plant are illustrated in Figure 2.1. This plan was reproduced from a fire insurance map stored at the Cambridge Gallery and Library. The fire insurance map was dated 1910 and was revised in 1918. Fire insurance maps are typically detailed site plans (to scale) of city blocks showing all building construction including materials. The original 1910 map depicted two large diameter gas holding tanks of 32,000 cubic foot and 15,000 cubic foot capacity respectively, separated by a large one-storey Purifying Retort building and several small storage buildings. The gas holding tanks measured approximately 2,400 square feet (55 feet diameter) and 1,600 square feet (45 feet diameter). The purifying-retort building measured approximately 2,500 square feet. The 1918 revised drawing does not record this layout. Figure 2.1 locates the above-mentioned tanks according to the 1910 survey. The Grand River shoreline configuration during the period was also recorded and is shown on Figure 2.1.

Based upon the above and the MOE release dated January 20, 1987 listing former coal gasification plant sites, the operations at

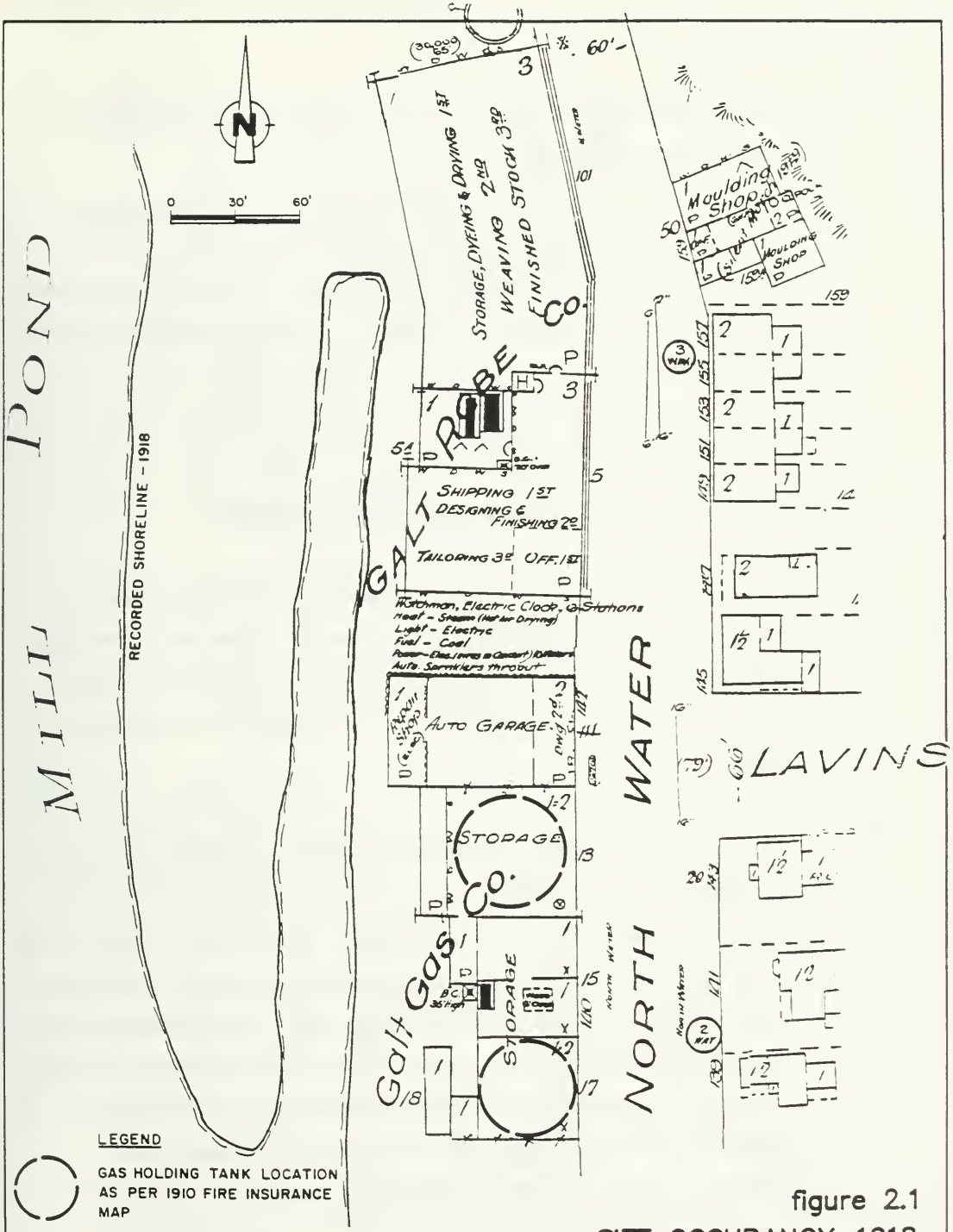


figure 2.1
SITE OCCUPANCY–1918

this plant started in the late 19th Century and ended prior to World War I (approximately 1886-1910).

Concurrent with coal gasification operations was the operation of the Galt Robe Company immediately to the north. The building consisted of one large three-storey structure. A lumber yard occupied the area to the south.

2.2 POST-CLOSURE OF GAS WORKS (1910-PRESENT)

Between 1910 and 1918, as indicated by the revised fire insurance map, the coal gasification operations had ceased and the structures were utilized for storage. In addition an auto garage and repair shop had located immediately adjacent to, and north of, the former coal gasification plant.

Figure 2.2 presents the property development/occupancy as defined on a 1941 Provincial Insurance Survey Map obtained from the Gore-Mutual Insurance Company, Cambridge. As indicated on Figure 2.2, the Grand River shoreline has been partially changed, presumably by filling, and the textile mill expanded over the former gas plant. The total frontage of the textile mill along Water Street was on the order of 520 feet as scaled from the 1941 plan. Measurements taken at the property during the investigative program confirm the frontage to be 530 feet indicating generally good agreement with the 1941 record. The construction history of the property remains relatively unchanged from 1941 until the present. Several

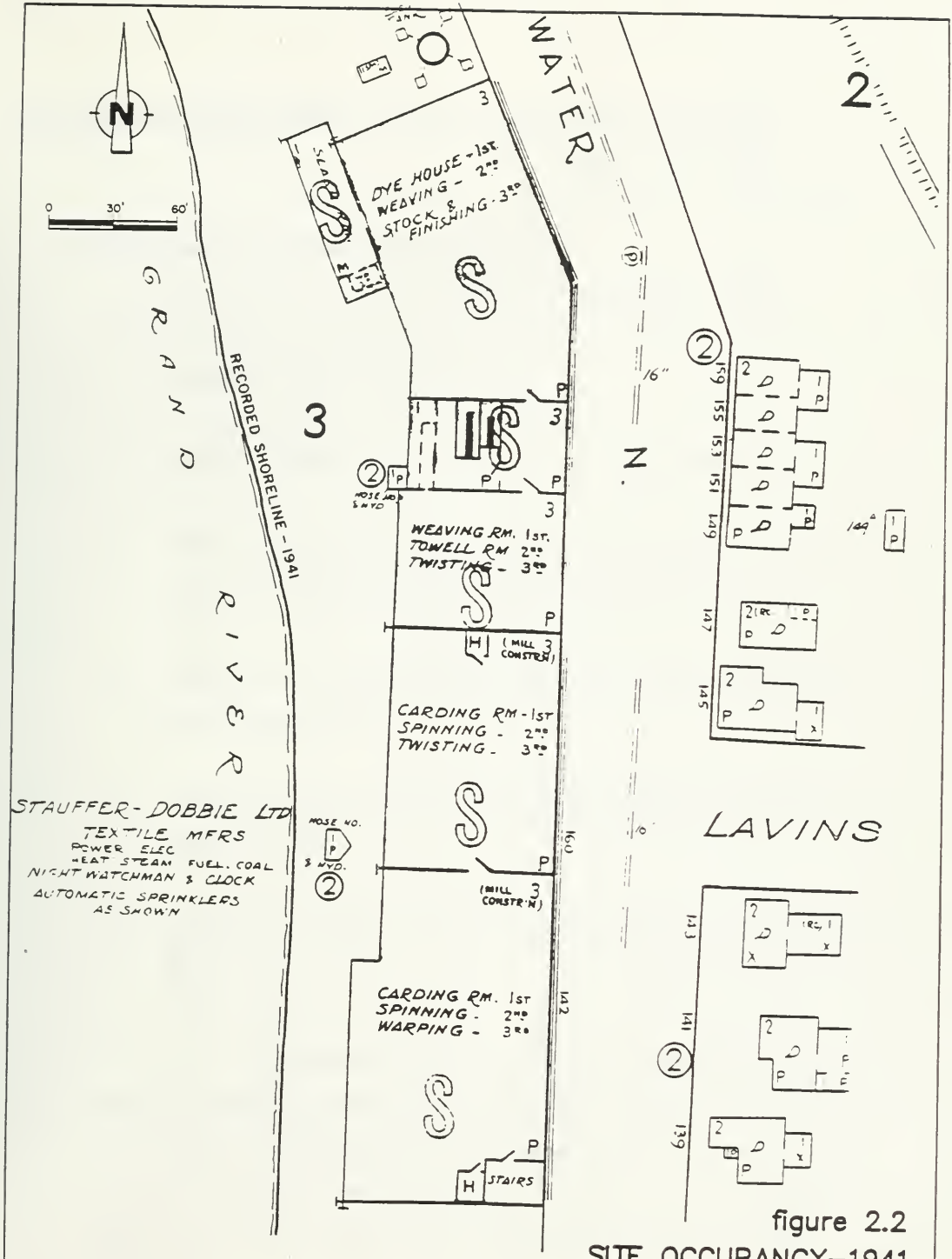


figure 2.2
SITE OCCUPANCY—1941

gasoline/service stations were apparently located along the east side of Water Street in recent years.

The textile mill was demolished to grade in the early 1980s. The basement floor slab and foundation walls still exist.

3.0 FIELD INVESTIGATION

Field investigations by CRA have been conducted in four phases and have consisted of the following:

i) Drilling of 21 boreholes to determine geologic conditions and the presence of coal tar contamination.

ii) Collection and chemical analysis of 16 soil samples from boreholes.

iii) Installation of four monitoring wells to allow groundwater sample collection and for determining groundwater flow direction.

iv) Collection and chemical analysis of groundwater/fluid samples from three monitoring wells.

v) Inspection of the bottom of the Grand River adjacent to the former coal gasification plant.

vi) Collection and analysis of water and sediment samples from the Grand River.

The first two phases of the field investigation included primarily borehole installation and were reported in September 1987(2). The third phase of the investigation included inspection of the Grand River and sampling of water and sediment from the river. This work was completed in early 1989. The fourth phase included installation of additional boreholes

and monitoring wells and additional sampling of water from the Grand River. This work was completed in the spring of 1990.

3.1 PHASE I AND II INVESTIGATIONS

The field investigation methods for Phase I and II are described in the September 1987 report (2). During Phase I and II, 13 boreholes were advanced using hollow stem or solid stem augers and one monitoring well was installed to monitor the presence of coal tar or groundwater contamination. Soil and groundwater samples were collected for analysis. Boreholes were drilled at the property prior to the coal tar investigation by Peto-MacCallum Ltd. This work was part of the geotechnical investigation for the proposed property re-development.

3.2 PHASE III INVESTIGATION

Phase III consisted of an underwater investigation of the Grand River bottom by Integrated Explorations Ltd. of Guelph, Ontario under the direction of CRA. The report of the investigation is contained in Appendix A. The river bottom was visually inspected and the sediments were "probed" over a 50 metres by 50 metres area adjacent to the former coal gasification plant as shown on Figure 3.1. Water and sediment samples were collected for analysis.

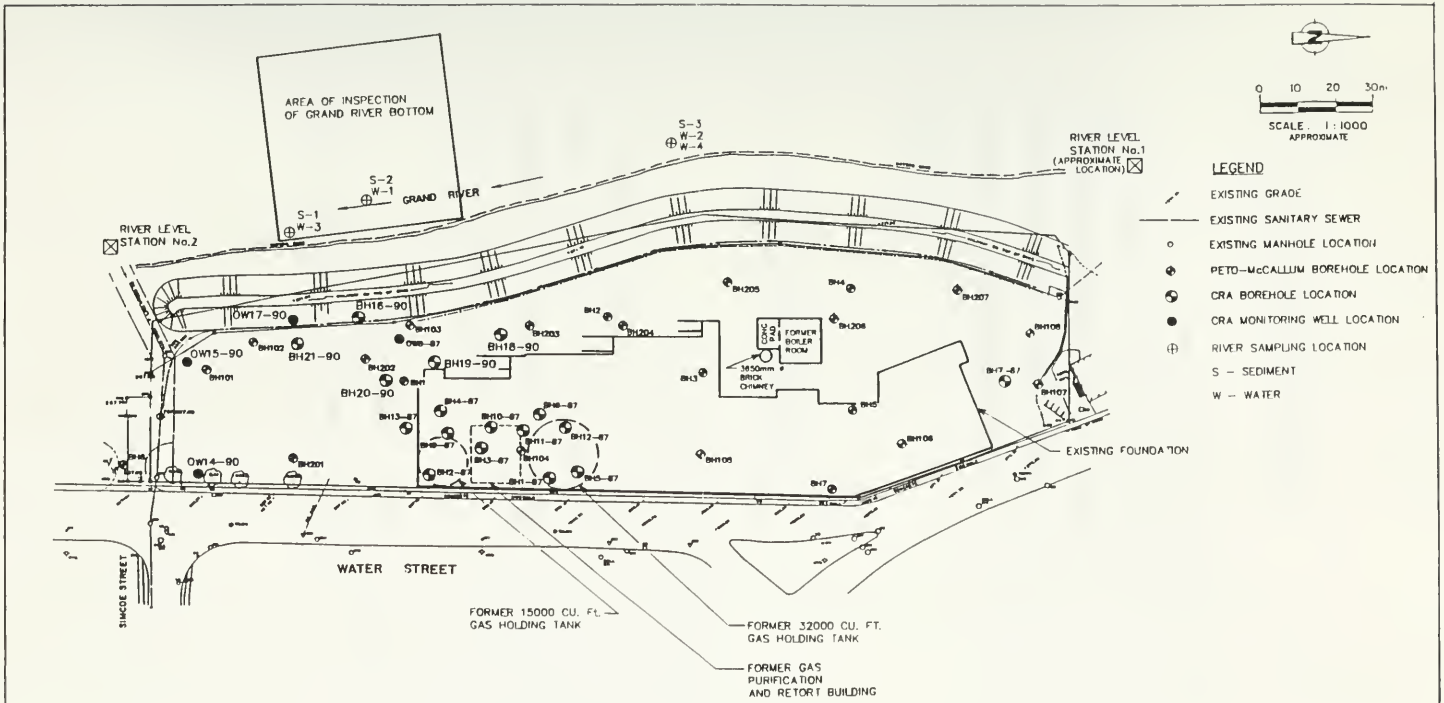


figure 3.1

LOCATION OF BOREHOLES, MONITORING WELLS AND RIVER SAMPLING/INSPECTION

2087-16/05/90 4-0

3.3 PHASE IV INVESTIGATION

The Phase IV investigation included the items described in the Proposal for Additional Investigative Work (1) (i.e. drilling of boreholes, installation of three monitoring wells and sampling of water in the Grand River). The work was conducted during the period of February to May 1990. The field methods for the Phase IV work are described in Appendix B.

3.4 FIELD DATA SUMMARY

Borehole logs for all borehole and well installations (including boreholes by Peto-MacCallum) are included in Appendix C. Additional field data which was collected (i.e. grain size data) are included in Appendix D. The locations of all boreholes, monitoring wells and river sampling points are shown on Figure 3.1 (presented previously).

Analytical reports for all samples collected during the entire program are contained in Appendix E.

4.0 GEOLOGY/HYDROGEOLOGY

4.1 GEOLOGY

Geologic cross-sections are used to illustrate geologic conditions. Cross-section locations are shown on Figure 4.1. The geological setting beneath the property, as shown on cross-section Figures 4.2, 4.3 and 4.4, is represented by fill overlaying an upper sequence of sands (SM, SP and SW) overlay a basal sand and gravel unit (SW-GP). A silt (ML) bed, of approximately 0.5 metre thickness, is found between these clastic units in the eastern area of the site as shown on Figure 4.2. An organic silt (OL) is noted to overlie the upper sands in the western areas of the site as shown on Figure 4.3. The soil classifications are from the modified Unified Soil Classification system and are defined in Appendix C.

The basal sand and gravel unit consists of a dense to very dense coarse sand and gravel with occasional cobbles. This unit is found approximately 4.0 to 8.0 metres below the surface and is inferred to be 2.0 to 5.0 metres thick, extending to the bedrock surface, approximately 5.0 to 12.0 metres below the surface.

The upper sands consist of a poorly to well graded, fine to coarse grained sand with occasional silt seams and traces of gravel. The sands are found approximately 1.5 to 5.0 metres below the ground surface and vary in thickness from 1.0 to 5.0 metres. The unit is continuous under the property but, terminates abruptly at the western property boundary as shown on Figure 4.4.

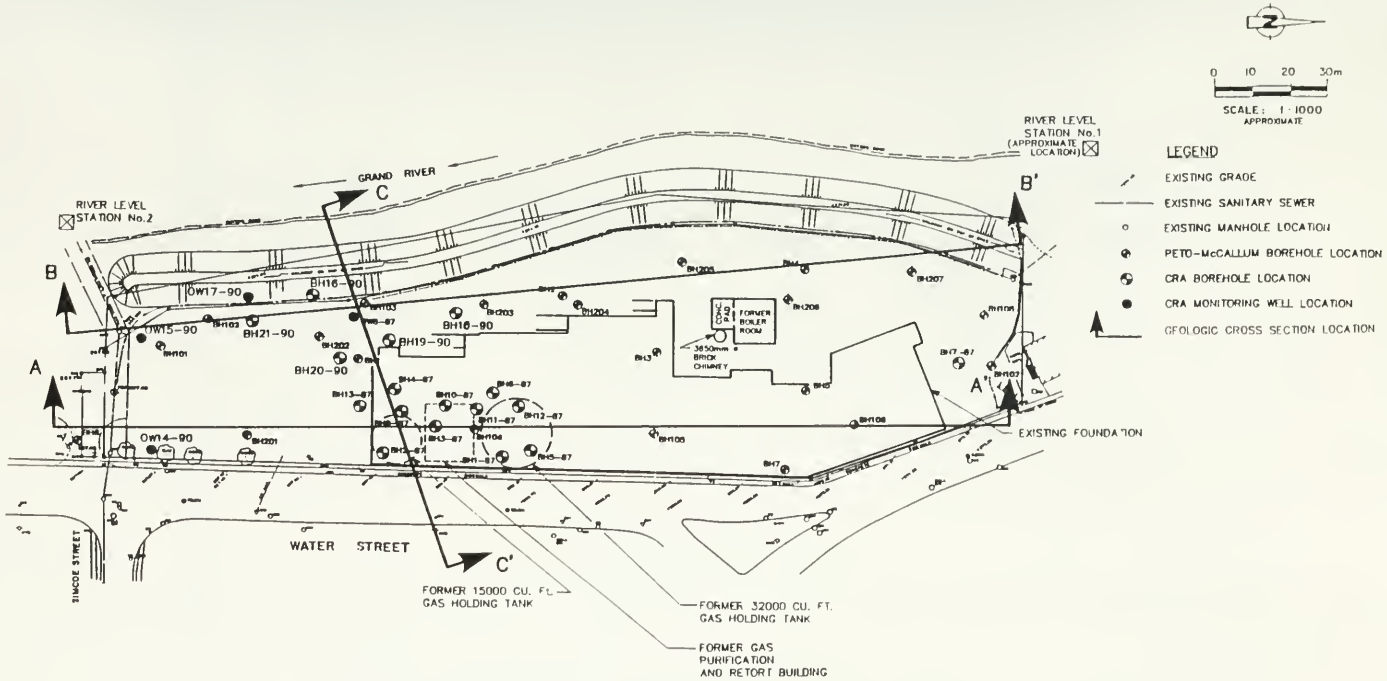


figure 4.1
GEOLOGIC CROSS SECTION LOCATIONS

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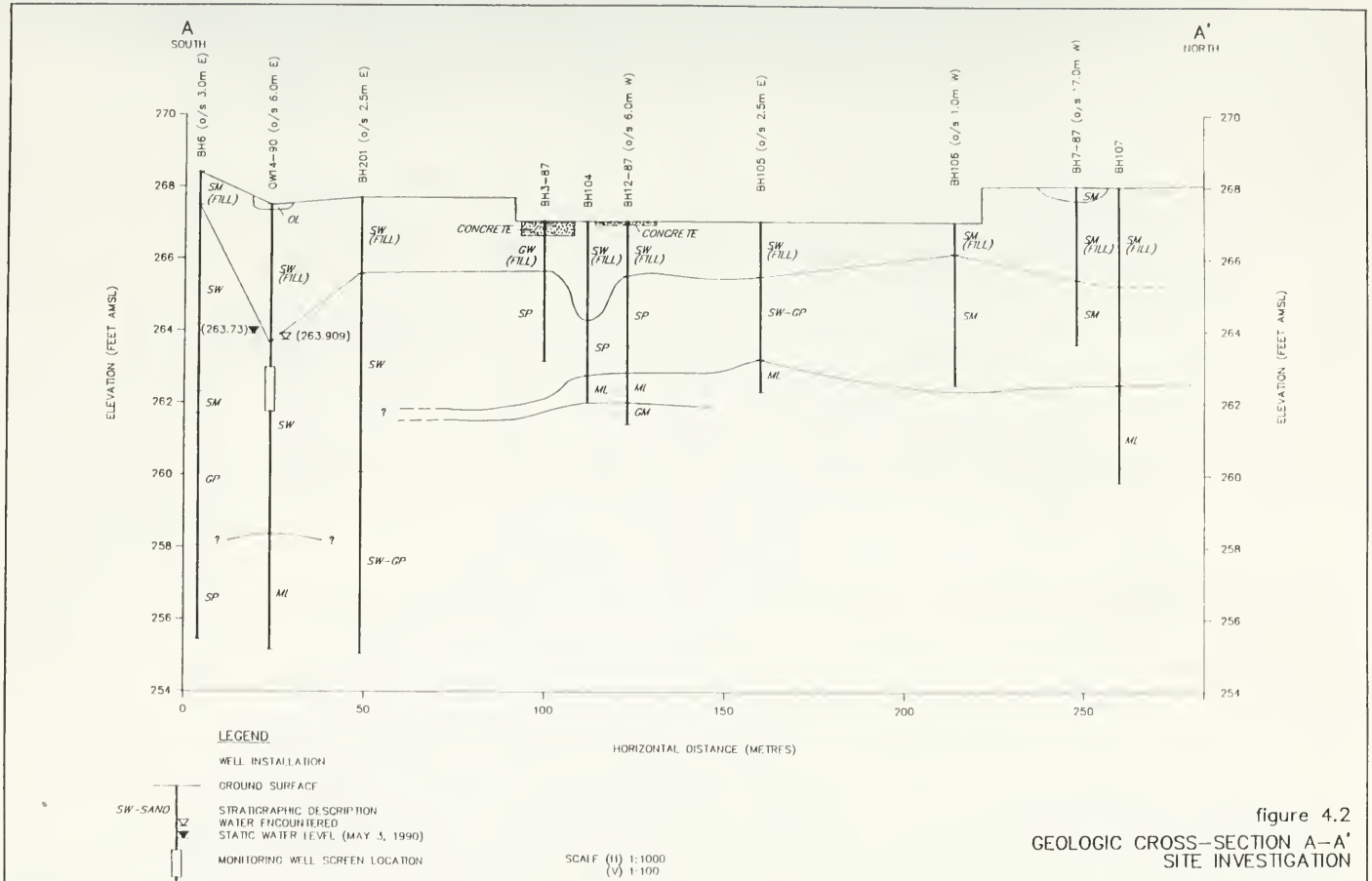


figure 4.2
GEOLOGIC CROSS-SECTION A-A'
SITE INVESTIGATION

2087-11/05/90-4-0 (X-01)

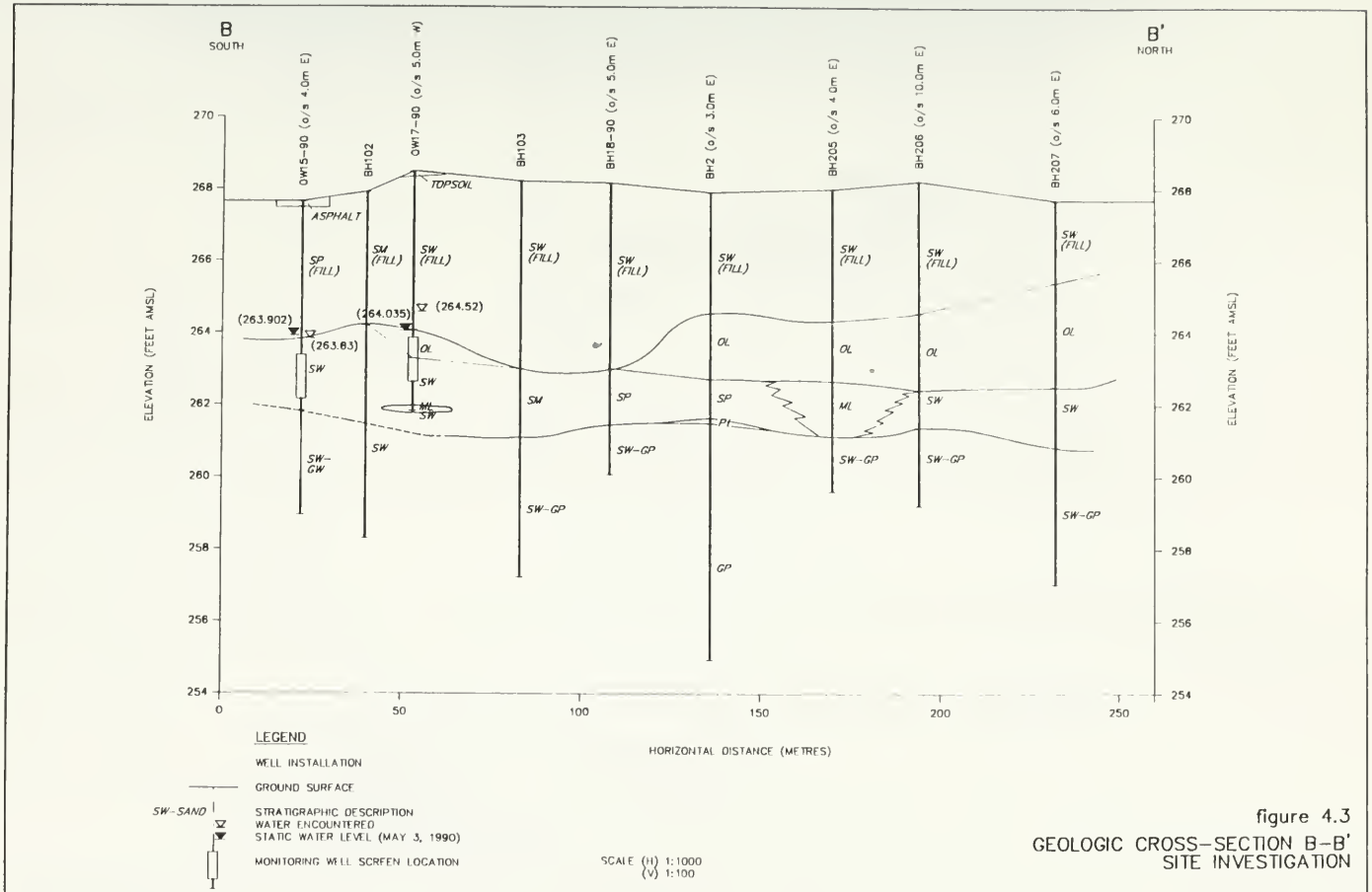


figure 4.3
GEOLOGIC CROSS-SECTION B-B'
SITE INVESTIGATION

2087-11/05/90-4-0 (X-02)

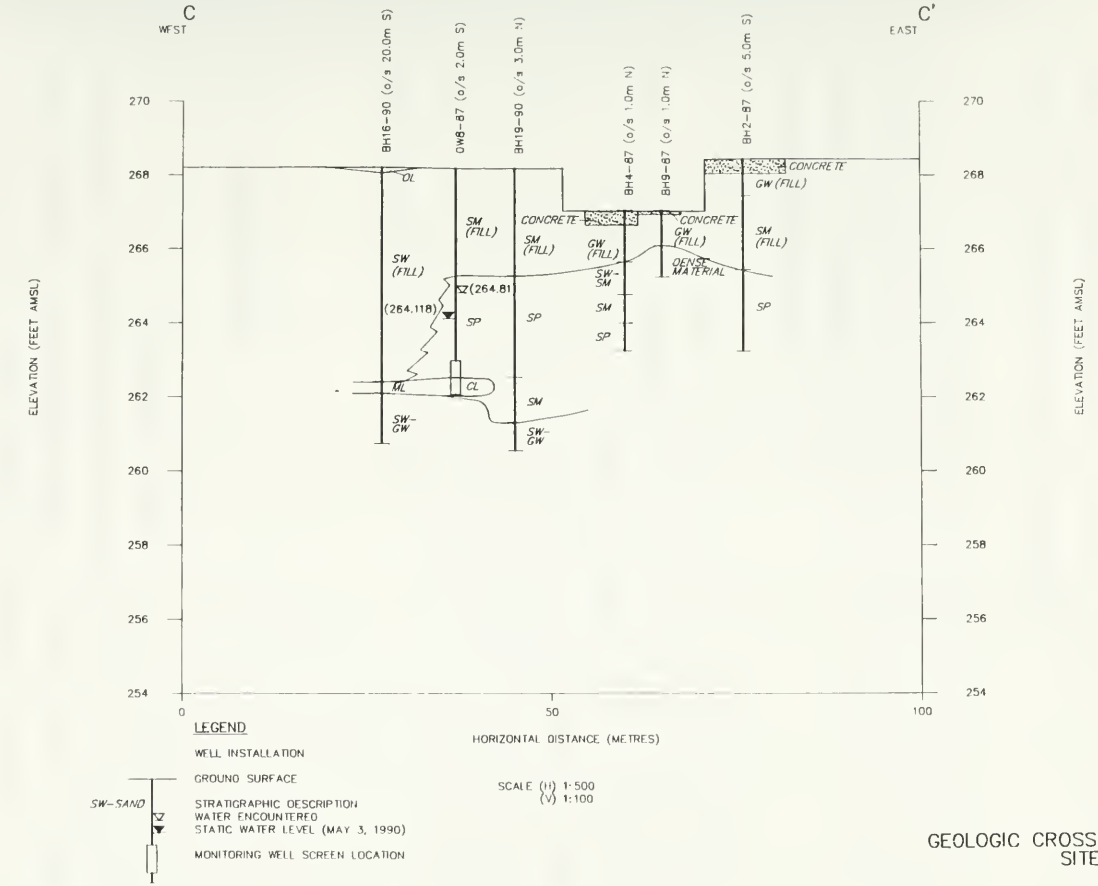


figure 4.4
GEOLOGIC CROSS-SECTION C-C'
SITE INVESTIGATION

2087 16/05/90-4-0 (X-03)

A silt or sandy silt bed of approximately 0.5 metres thickness is found stratigraphically between the upper sands and basal sand and gravel in the eastern portion of the property.

Loose, dark gray, organic silts with occasional sand seams are found in a limited area of the northwest quarter of the property as shown on Figure 4.2. These organic silts directly overly the upper sands and are approximately 2.0 metres in thickness.

The entire property is covered by a sand fill containing occasional gravel and limited amounts of construction rubble (brick pieces). This fill tends to increase in thickness from approximately 2.0 metres at the eastern property boundary, near Water Street, to approximately 5.0 metres at the western property boundary adjacent to the Grand River. It is believed that the shoreline of the Grand River was extended westward from Water Street by the placement of these fill materials.

4.2 HYDROGEOLOGY

A water table aquifer is found within the native sands at the property. The water table is approximately 3.5 to 4.5 metres below the ground surface or at an elevation ranging from 263.902 to 264.118 metres above mean sea level (AMSL). Table 4.1 summarizes the historical water level data.

TABLE 4.1

SUMMARY OF WATER ELEVATION DATA

		Water Elevation (m. AMSL)						
	Ref. Elev.	*4/29/87*	*2/27/90*	*3/14/90*	*3/26/90*	*5/3/90*	*5/22/90*	*12/11/90*
Well Number								
OW8-87	269.178	264.548	264.298	264.718	264.438	264.118	264.498	264.418
OW14-90	268.409	--	264.049	264.459	264.299	263.909	264.279	264.249
OW15-90	268.542	--	264.052	264.502	264.272	263.902	264.312	264.232
OW17-90	269.560	--	264.210	264.540	264.380	264.035	264.360	264.330
River Station								
Number 1 (upstream)	265.715	--	--	--	264.824	264.815	--	--
Number 2 (downstream)	265.267	--	--	--	264.794	264.767	--	--

4.2.1 Groundwater Flow

Groundwater flow within the water table aquifer is in a southerly direction, parallel to that of the Grand River as indicated by the water level data presented in Table 4.1, which were collected during spring and late fall conditions in 1990. This parallel groundwater flow pattern is thought to be significantly influenced by the Parkhill Dam immediately downstream of the property. During the period of water level measurements, the water elevation in the Grand River was found to be higher than the groundwater elevations on the property. This may be due to seasonal effects. Figure 4.5 illustrates the groundwater contours for May 3, 1990 taken from four groundwater observation wells: OW8-87, OW14-90, OW15-90 and OW17-90.

4.2.2 Hydraulic Conductivity

The in situ hydraulic conductivity of the screened material of groundwater monitoring wells OW14-90 and OW15-90 was determined by single well response testing of the wells. Data from these tests are presented in Appendix D. The hydraulic conductivity of these wells, as calculated following Hvorslev (1951) (5) is 1.0×10^{-3} cm/sec and 6.0×10^{-5} cm/sec, respectively. The geometric mean of these values is 2.4×10^{-5} cm/sec and is used to characterize the hydraulic conductivity of the aquifer.

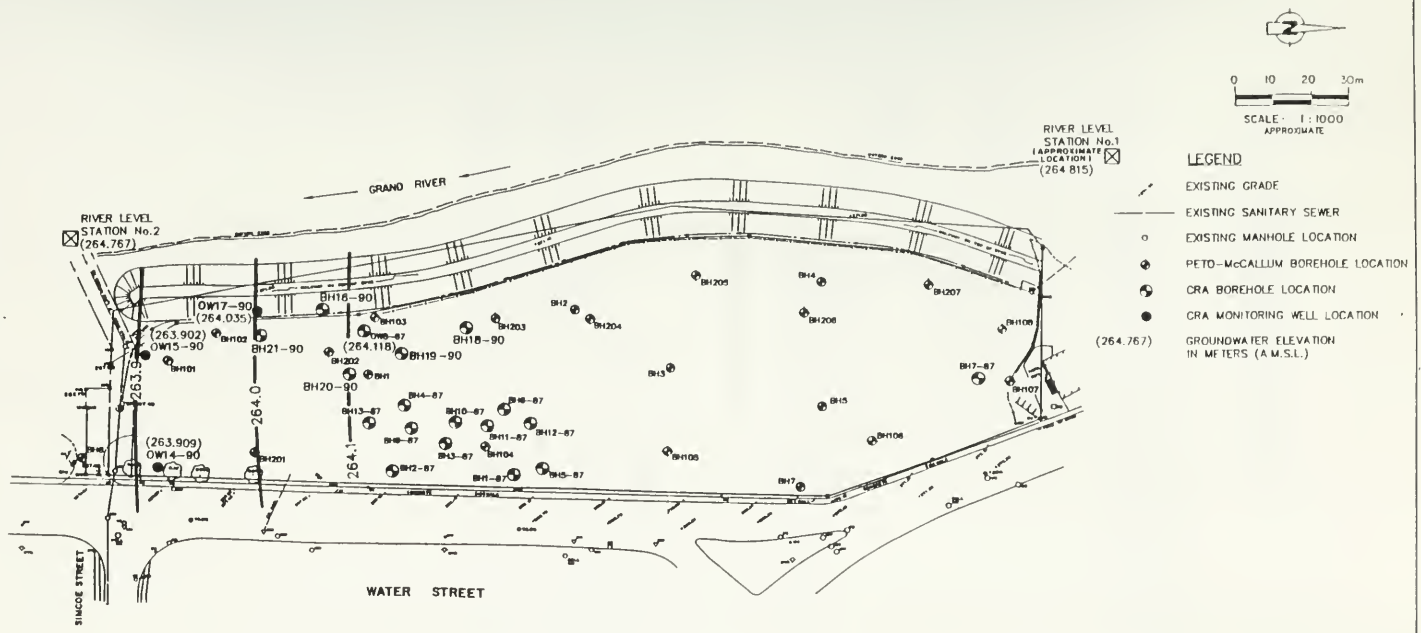


figure 4.5
GROUNDWATER CONTOURS
MAY 3, 1990

2087-16/05/90-4-0

4.2.3 Groundwater Flow Velocity

The average horizontal groundwater flow velocity can be determined using the modified Darcy equation:

$$\overline{V} = \frac{K\,i}{n}$$

where:

K - hydraulic conductivity,

i - horizontal hydraulic gradient, and

n - effective porosity.

Using the geometric mean of the hydraulic conductivity of 2.4×10^{-6} m/sec (2.4×10^{-4} cm/sec), a horizontal hydraulic gradient of 0.0036 (m/m) and an assumed effective porosity of 0.30, a horizontal linear groundwater velocity of 2.9×10^{-8} m/sec or 0.93 m/yr is calculated.

5.0 CONTAMINANT DISTRIBUTION

5.1 SOIL

5.1.1 Summary of Borehole Observations

A total of 22 boreholes were completed by Peto-MacCallum Ltd. (Peto) for geotechnical investigation as discussed in the September 1987 report (2). Peto reported oil odours in several samples recovered during the investigation. Table 5.1 presents a summary of the location, depth and soil stratigraphy where the odours were reported.

The location of soil borings conducted by CRA in 1987 were selected on the basis of information from Peto borings, the location of the former coal gasification plant and the location of potential areas of contact with subsurface material during the proposed property development.

The soil borings conducted in 1990 by CRA were placed to define the extent of contamination outside of the limits of the former coal gasification plant and for installation of monitoring wells at the southern property boundary. In addition, a total of two boreholes and one monitoring well were to be placed through the top of the GRCA flood control berm. This part of the program was modified, in consultation with the MOE, because of difficulties and safety concerns regarding access of drilling equipment to the top of the berm. Two holes were drilled on the side of the berm (BH16-90, OW17-90) on GRCA property. One of these two boreholes (OW17-90) was completed as an observation well.

TABLE 5.1

SUMMARY OF ODOURS
REPORTED IN GEOTECHNICAL SOIL BORINGS

Borehole	*Depth ft (m) BGS*	*Geodetic Elev. ft (m) AMSL*	*Soil/Odour[1] Description*	*Remarks*
103	12.5 (3.81)	868 (264.56)	Sand and Silt Fill/ Strong oil smell	West of reported gas holder location
104	11 (3.35)	865 (263.66)	Coarse Sand/Strong smell of oil	Inside purifying retort building
202	10 (3.05)	870 (265.18)	Sand and Gravel Fill/Strong smell of oil	West of reported gas holder location
108	15 (4.57)	863 (263.05)	Fine to Medium Sand/ Strong smell of oil	Near north property limit

Note:

(1) As presented by Peto-MacCallum Ltd.

Table 5.2 contains a summary of the contamination noted in the soil borings conducted by CRA in 1987 and 1990. Figure 5.1 shows in plan view the locations where contamination was noted. From this information, the following general observations are made:

i) Concrete material is present beneath the existing textile mill foundation where the former coal gasification plant was located.

ii) Odours of coal tar, gasoline and diesel fuel are noted in the area of the former coal gasification plant.

iii) The contamination is generally not encountered until the water table is reached.

iv) The boreholes exhibiting the greatest amount of coal tar contamination are OW8-87, BH10-87 and BH13-87.

v) A coal tar odour is noted at the north end of the property along with coal fragments.

vi) Odours are noted in boreholes installed on GRCA property.

vii) Contamination is not noted at boreholes on the southern property boundary (OW14-90, OW15-90).

TABLE 5.2

SUMMARY OF CONTAMINATION NOTED IN
1987 AND 1990 SOIL BORINGS

Borehole	*Description*
BH1-87	- none
BH2-87	- strong coal tar odour at water table (El. 263.8 m)
BH3-87	- coal tar odour at water table (El. 264.8 m) - strong gasoline odour (El. 263.7 m)
BH4-87	- strong coal tar odour at water table (El. 264.6 m) - strong gasoline odour (El. 264.0 m)
BH5-87	- none
BH6-87	- strong coal tar odour beneath buried concrete slab (El. 264.6 m)
BH7-87	- coal tar odour (El. 267.0 m)
OW8-87	- strong coal tar odour and coal tar at water table (El. 264.8 m) down to and into fine grained layer (El. 262.0 m)
BH9-87	- slight coal tar odour above probable concrete (El. 266.0 m)
BH10-87	- diesel fuel odour at water table (El. 264.8 m) - strong coal tar odour and coal tar (El. 263.0 m)
BH11-87	- strong diesel fuel odour at water table (El. 264.8 m)
BH12-87	- strong diesel odour at water table (El. 265.0 m)
BH13-87	- slight coal tar odour at water table (El. 264.5 m) with increasing coal tar odour with depth - coal tar saturated above thin silt/sand layer (El. 262.2 m)
OW14-90	- none
OW15-90	- none
BH16-90	- very slight odour (El. 263.7 m) - slight odour, water discoloured (El. 262.3 m) - moderate odour in sand/gravel below silt layer (El. 261.0 m)
OW17-90	- slight odour in silt layer (El. 264.0 m) - slight odour in sand layer (El. 263.0 m)
BH18-90	- strong odour and sheen (El. 263.0 m) - strong odour and product (El. 262.0 m)
BH19-90	- none
BH20-90	- strong odour and product (El. 262.5 m)
BH21-90	- none

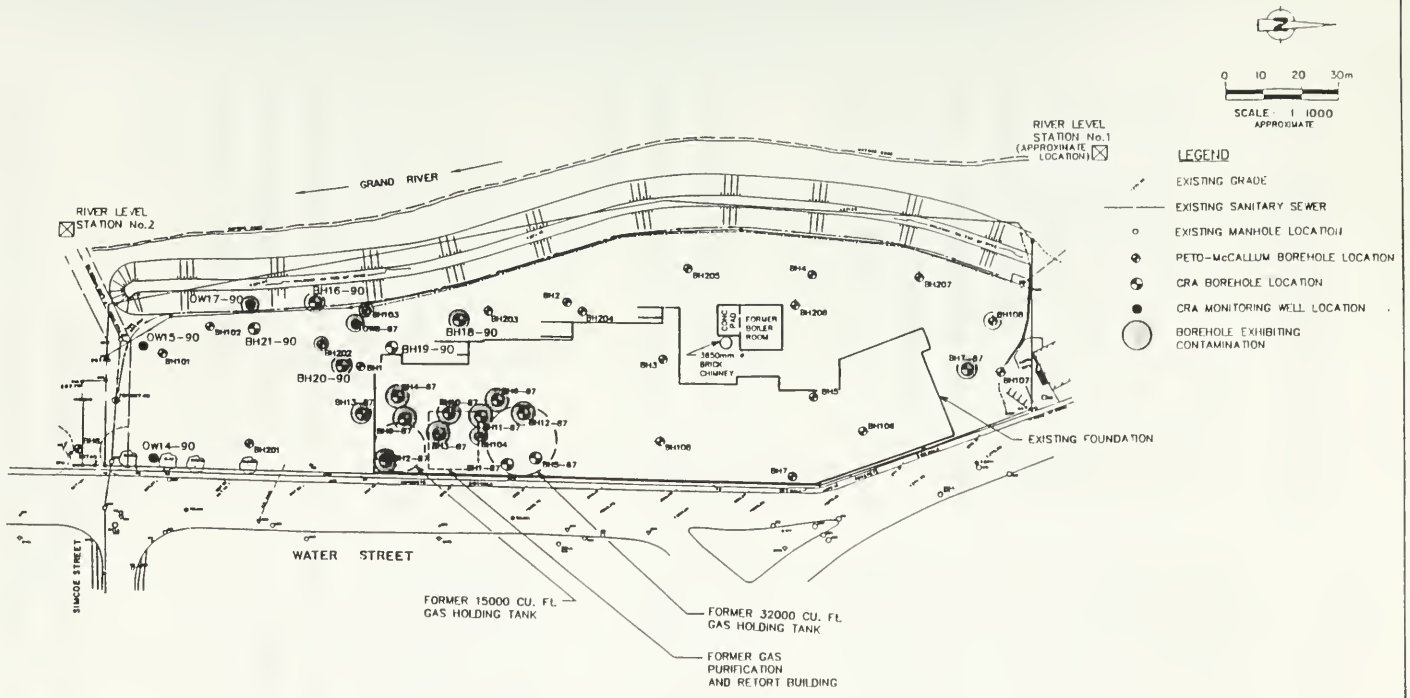


figure 5.1
LOCATION OF BOREHOLES EXHIBITING CONTAMINATION

5.1.2 Analytical Results of Soil Samples

During Phase I, two soil samples were analyzed for the indicator polynuclear aromatic hydrocarbons (PAHs); naphthalene and benzo(a)pyrene. These compounds were selected as indicators because of mobility (naphthalene) and carcinogenicity (benzo(a)pyrene). The results are contained in Table 5.3. One sample was obtained from the vicinity of the former coal gasification plant (BH6-87) and the other was obtained from the north end of the property (BH7-87) where odours were noted from the geotechnical investigation. The only detection was naphthalene at BH6-87.

During Phase II, ten soil samples were analyzed for PAHs in leachate from soil and two soil samples were analyzed for total concentration of PAHs. These results are contained in Tables 5.4 and 5.5, respectively.

As shown in Table 5.4, benzo(a)pyrene was not detected in any of the leach samples. There were no detections of PAHs in the leach samples collected from the unsaturated zone. Various PAHs were detected in the leach samples collected from the saturated zone. The number of PAH compounds and their concentrations in the leach samples collected from within the silt layer at BH10-87 (4.6 - 5.2 m) are significantly lower than those of samples collected in the saturated zone above the silt layer at the same borehole.

With respect to the total PAH concentrations shown in Table 5.5, several PAHs including benzo(a)pyrene were detected in soil

TABLE 5.3

PHASE I ANALYTICAL RESULTS
PAHs IN SOIL

Sample Location	*Depth m (ft)*	*Concentration (ppm)* (1) *Naphthalene*	*Benzo(a)pyrene*
BH6-87	2.4 (8)	2.38	<0.5
BH7-87	3.0-3.6 (10-12)	<0.05	<0.05

Notes:

1. Total concentration in soil

TABLE 5.4

PHASE II ANALYTICAL RESULTS
PAHs IN SOIL LEACH

PAH Compound (µg/L)	OW8-87 3.8-4.4 m (12.5-14.5 ft)	[5]	MDL	BH10-87 1.5-2.1 m (5.0-7.0 ft)	[4]	MDL	2.3-2.9 m (7.5-9.5 ft)	[5]	MDL	3.8-4.4 m (12.5-14.5 ft)	[5]	MDL	4.6-5.2 m (15.0-17.0 ft)	[6]	MDL
Acenaphthene	50.4		0.2	-		0.1	27.1		0.1	3.4		1	0.5		0.1
Acenaphthylene	2.7		0.2	-		0.1	0.4		0.1	355		1	-		0.1
Anthracene	0.5		0.2	-		0.1	1		0.1	21		1	-		0.1
Benz(a)Anthracene+Chrysene	-		0.2	-		0.1	-		0.1	-		1	-		0.1
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	-		0.2	-		0.1	-		0.1	-		2	-		0.1
Benzo(a)Pyrene	-		0.2	-		0.1	-		0.1	-		2	-		0.1
Benzo(g,h,i)Perylene	-		0.4	-		0.2	-		0.2	-		5	-		0.2
Dibenz(a,h)Anthracene	-		0.4	-		0.2	-		0.2	-		5	-		0.2
Fluoranthene	-		0.2	-		0.1	0.2		0.1	5.6		1	-		0.1
Fluorene	6.7		0.2	-		0.1	5.1		0.1	82		1	-		0.1
Indeno(1,2,3-cd)Pyrene	-		0.4	-		0.2	-		0.2	-		5	-		0.2
Naphthalene	240		0.2	-		0.1	0.3		0.1	777		1	1.4		0.1
Phenanthrene	6.6		0.2	-		0.1	6		0.1	160		1	-		0.1
Pyrene	-		0.2	-		0.1	0.5		0.1	6.1		1	-		0.1

TABLE 5.4

PHASE II ANALYTICAL RESULTS
PAHs IN SOIL LEACH

PAH Compound (µg/L)	BH11-87 2.3-2.9 m (7.5-9.5 ft) [5]	MDL	BH12-87 0.75-1.35 m (2.5-4.5 ft) [4]	MDL	2.3-2.9 m (7.5-9.5 ft) [5]	MDL	BH13-87 1.5-2.1 m (5.0-7.0 ft) [4]	MDL	5.3-5.9 m (17.5-19.5 ft) [5]	MDL
Acenaphthene	0.3	0.1	-	0.1	-	0.1	-	0.1	47.7	1
Acenaphthylene	-	0.1	-	0.1	-	0.1	-	0.1	283	1
Anthracene	-	0.1	-	0.1	-	0.1	-	0.1	6.2	1
Benz(a)Anthracene+Chrysene	-	0.1	-	0.1	-	0.1	-	0.1	-	1
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	-	0.1	-	0.1	-	0.1	-	0.1	-	2
Benzo(a)Pyrene	-	0.1	-	0.1	-	0.1	-	0.1	-	2
Benzo(g,h,i)Perylene	-	0.2	-	0.2	-	0.2	-	0.2	-	5
Dibenz(a,h)Anthracene	-	0.2	-	0.2	-	0.2	-	0.2	-	5
Fluoranthene	-	0.1	-	0.1	-	0.1	-	0.1	3.5	1
Fluorene	0.2	0.1	-	0.1	-	0.1	-	0.1	82	1
Indeno(1,2,3-cd)Pyrene	-	0.2	-	0.2	-	0.2	-	0.2	-	5
Naphthalene	1.6	0.1	-	0.1	-	0.1	-	0.1	10,550	1
Phenanthrene	0.4	0.1	-	0.1	0.2	0.1	-	0.1	117	1
Pyrene	-	0.1	-	0.1	-	0.1	-	0.1	5.7	1

Notes:

[1] MDL = Method Detection Limit
[2] Blank value indicates compound not detected at the MDL
[3] Total concentration in soil leach
[4] Sample from unsaturated zone
[5] Sample from saturated zone
[6] Sample from within or below silt layer

TABLE 5.5

PHASE II ANALYTICAL RESULTS
PAHs IN SOIL

	BH13-87		*OW8-87*	
PAH Compound (ppm)	*5.3-5.9 m (17.5-19.5 ft)*	*MDL*	*3.8-4.4 m (12.5-14.5 ft)*	*MDL*
Acenaphthene	2,230	30	--	3
Acenaphthylene	160	30	89.2	3
Anthracene	1,250	30	55.8	3
Benz(a)Anthracene	400	30	11.3	3
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	420	50	TR	5
Benzo(a)Pyrene	530	50	TR	5
Benzo(g,h,i)Perylene	330	150	--	15
Chrysene	640	30	23.7	3
Dibenz(a,h)Anthracene	--	150	--	15
Fluoranthene	2,400	30	112	3
Fluorene	780	30	16.1	3
Indeno(1,2,3-cd)Pyrene	220	150	--	15
Naphthalene	10,300	30	180	3
Phenanthrene	5,250	30	188	3
Pyrene	510	30	24.8	3

Notes:

1. MDL = Method Detection Limit
2. Blank value indicates compound not detected at the MDL
3. TR = Trace
4. Total concentration in soil

samples. The concentrations present are higher in the vicinity of the former coal gasification plan (BH13-87) than at the property boundary (OW8-87). However, these samples were obtained from different depth horizons, and the concentrations of PAHs at a given location are expected to vary with depth due to the gravity effect on coal tar migration.

During Phase IV, two soil samples were collected and analyzed for PAHs and metals. These results are contained in Table 5.6. The samples were collected from the southern property boundary (OW14-90) and beneath the GRCA flood control berm (OW17-90). These samples were obtained from the saturated soil zone.

With respect to the PAH data, there were no detections at OW14-90 and there were several detections at OW17-90 at concentrations of approximately 1 ppm or less. The concentrations found at OW17-90 are significantly lower than those at OW8-87 which is approximately 30 metres upgradient of OW17-90 with respect to groundwater flow. This would be expected if the contaminants at OW17-90 were present as a result of transport with groundwater. With respect to the metals data, the concentrations present in both samples are similar to background concentrations of metals in surface soil in an urban location. The concentrations present are similar to or lower than the upper limits of normal concentrations in Ontario urban surface soil presented by the MOE (3).

TABLE 5.6

PHASE IV ANALYTICAL RESULTS
PAHs AND METALS IN SOIL

Parameter	*Sample Location*	
	OW14-90 (3.81 - 4.42m)	*OW17-90 (5.33 - 5.94 m)*
PAHs (ppm)		
Acenaphthene	<0.05	0.69
Acenaphthylene	<0.05	0.05
Anthracene	<0.05	0.35
Benz(a)anthracene	<0.05	0.19
Benzo(b)fluoranthene and Benzo(k)fluoranthene	<0.12	0.24
Benzo(a)pyrene	<0.1	0.2
Benzo(g,h,i)perylene	<0.2	<0.2
Chrysene	<0.05	0.21
Fluoranthene	<0.05	0.53
Fluorene	<0.05	0.32
Indeno(1,2,3-cd)pyrene and Dibenz(a,h)anthracene	<0.25	<0.25
Naphthalene	<0.05	0.42
Phenanthrene	<0.05	1.2
Pyrene	<0.05	0.75
Metals (ppm)		
Hexavalent Chromium	0.179	0.28
Zinc	56	89/92
Cadmium	0.10	0.30/0.40
Cobalt	2.5	2.5/2.5
Copper	13.5	14.5/12.5
Lead	5.0	18.0/20.0
Chromium	17	23/24
Nickel	9	12/13
Beryllium	<1	<1/<2
Molybdenum	4	4/4
Vanadium	14	24/27
Barium	17	38/42
Mercury	<0.02	<0.02
Arsenic	<0.5	3.0/3
Selenium	<0.5	<0.5/<1
Silver	<0.5	<0.5/<1
Antimony	<1	<1/<2

5.2 GROUNDWATER

Monitoring wells OW8-87 and OW17-90 have been noted to contain non-aqueous phase liquids (e.g. oil, tar). A fluid sample was collected from OW8-87 and analyzed for PAHs as part of Phase II. This sample contained elevated concentrations of PAHs and VOCs but the sample is not indicative of groundwater quality. The analytical results for this sample are contained in Table 5.7. Monitoring well OW17-90 was not sampled since the well contains non-aqueous phase liquids which would interfere with the assessment of groundwater quality at this location.

As discussed in Section 4, groundwater flow at the property is towards the south. Monitoring wells OW14-90 and OW15-90 are expected to intercept floating and dissolved contaminants in groundwater which passes through the soil beneath the former coal gasification plant and vicinity.

The analytical results for groundwater samples collected in 1990 from OW14-90 and OW15-90 are contained in Table 5.8. PAHs were not detected in either sample. Volatile organic compounds (VOCs) were not detected in the sample from OW15-90. Several VOCs were detected in the sample from OW14-90 including chloroform, ethylbenzene and xylenes at concentrations of up to 4.3 µg/L. A total concentration of 16 µg/L of untargeted aromatic compounds was also detected. The VOCs which were detected in OW14-90 are not necessarily solely related to coal tar deposits, but may be related to petroleum products. An auto garage and some gasoline service stations are known to have existed in the area. These facilities would

TABLE 5.7

ANALYTICAL RESULTS OF FLUID SAMPLE FROM OW8-87

Compound	*MDL*	*OW8-87*
PAHs (µg/L)		
Acenaphthene	10	112
Acenaphthylene	10	19.3
Anthracene	10	126
Benz(a)Anthracene	10	33.7
Chrysene	10	52.5
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	20	41
Benzo(a)Pyrene	20	54.6
Benzo(g,h,i)Perylene	50	TR
Dibenz(a,h)Anthracene	50	-
Fluoranthene	10	239
Fluorene	10	303
Indeno(1,2,3-cd)Pyrene	50	TR
Naphthalene	10	8,788
Phenanthrene	10	805
Pyrene	10	267

TABLE 5.7

ANALYTICAL RESULTS OF FLUID SAMPLE FROM OW8-87

Compound	*MDL*	*OW8-87*
VOCs (µg/L)		
Benzene	1,000	8,940
Bromodichloromethane	100	-
Bromoform	500	-
Bromomethane	100	-
Carbon Tetrachloride	500	-
Chlorobenzene	100	-
Chloroethane	100	-
2-Chloroethyl Vinyl Ether	5,000	-
Chloroform	100	-
Chloromethane	100	-
Dibromochloromethane	100	-
1,2-Dichlorobenzene	150	-
1,3-Dichlorobenzene	150	-
1,4-Dichlorobenzene	150	-
1,1-Dichloroethylene	100	-
1,1-Dichloroethane	100	-
1,2-Dichloroethane	100	-
trans-1,2-Dichloroethylene	100	-
Dichloromethane	5,000	-
1,2-Dichloropropane	100	-
cis-1,3-Dichloropropene	250	-
trans-1,3-Dichloropropene	100	-
Ethylbenzene	50	5,000
A-Methylstyrene	50	130
Mesitylene	50	740
1,1,2,2-Tetrachloroethane	1,000	-
Tetrachloroethylene	100	-
Toluene	500	4,190
1,1,1-Trichloroethane	100	-
1,1,2-Trichloroethane	250	-
Trichloroethylene	100	-
Trichlorofluoromethane	500	-
m+p Xylene	50	1,410
o-Xylene	50	780
Vinyl Chloride	250	-
Other Aromatic Compounds	50	-

Notes:

1. MDL = Method Detection Limit
2. Blank value indicates not detected at the MDL
3. Other Aromatic Compounds = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene
4. TR = Trace

TABLE 5.8

ANALYTICAL RESULTS OF GROUNDWATER SAMPLES

Compound	*MDL*	*OW14-90*	OW15-90
PAHs (µg/L)			
Acenaphthene	1	ND	ND
Acenaphthylene	1	ND	ND
Anthracene	1	ND	ND
Benz(a)Anthracene	1	ND	ND
Benzo(b)Fluoranthene	1	ND	ND
Benzo(k)Fluoranthene	1	ND	ND
Benzo(a)Pyrene	1	ND	ND
Benzo(g,h,i)Perylene	2.5	ND	ND
Chrysene	1	ND	ND
Fluoranthene	1	ND	ND
Fluorene	1	ND	ND
Indeno(1,2,3-cd)Pyrene and Dibenz(a,h)Anthracene	3	ND	ND
Naphthalene	1	ND	ND
Phenanthrene	1	ND	ND
Pyrene	1	ND	ND

ANALYTICAL RESULTS OF GROUNDWATER SAMPLES

Compound	*MDL*	*OW14-90*	OW15-90
VOCs (µg/L)			
Benzene	1	ND	ND
Bromodichloromethane	1	ND	ND
Bromoform	2	ND	ND
Bromomethane	10	ND	ND
Carbon Tetrachloride	2	ND	ND
Chlorobenzene	1	ND	ND
Chloroethane	10	ND	ND
2-Chloroethyl Vinyl Ether	10	ND	ND
Chloroform	1	4.3	ND
Chloromethane	10	ND	ND
Dibromochloromethane	1	ND	ND
Dibromoethane	4	ND	ND
1,2-Dichlorobenzene	1	ND	ND
1,3-Dichlorobenzene	1	ND	ND
1,4-Dichlorobenzene	1	ND	ND
1,1-Dichloroethylene	1	ND	ND
1,1-Dichloroethane	1	ND	ND
1,2-Dichloroethane	2	ND	ND
trans-1,2-Dichloroethylene	1	ND	ND
Dichloromethane	5	ND	ND
1,2-Dichloropropane	1	ND	ND
cis-1,3-Dichloropropene	1	ND	ND
trans-1,3-Dichloropropene	1	ND	ND
Ethylbenzene	1	1.1	ND
A-Methylstyrene	1	ND	ND
Methylstyrene Isomers	1	ND	ND
Mesitylene	1	ND	ND
Styrene	2	ND	ND
1,1,2,2-Tetrachloroethane	2	ND	ND
Tetrachloroethylene	1	ND	ND
Toluene	2	ND	ND
1,1,1-Trichloroethane	2	ND	ND
1,1,2-Trichloroethane	1	ND	ND
Trichloroethylene	1	ND	ND
Trichlorofluoromethane	2	ND	ND
m+p Xylene	2	TR	ND
o-Xylene	1	1.5	ND
Vinyl Chloride	5	ND	ND
Other Aromatic Compounds	1	16	ND

Notes:

1. ND = Not Detected
2. TR = Trace
3. Other aromatic compounds = total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

likely have had underground storage tanks which could have leaked into the ground in the past.

The non-aqueous phase liquids which are encountered in the boreholes and at well locations OW8-87 and OW17-90 represent a potential source of groundwater contamination. The ultimate discharge point of groundwater is undefined, however it appears that coal tar material in the saturated soil zone does not readily solubilize into groundwater and migrate, as evidenced by the analytical results of soil and water samples from monitoring wells OW14-90 and OW15-90.

5.3 GRAND RIVER WATER AND SEDIMENT

The underwater inspection of the Grand River was carried out over a 50 metre by 50 metre area as shown on Figure 3.1 presented previously. The intensity of the search pattern by the diver was greatest near the shore as discussed in the report by Integrated Explorations (Appendix A). The diver visually observed the bottom sediments and used white plastic probes driven 75 to 150 millimetres into the soil every 0.6 to 1.0 metres to detect any buried coal tar. Coal tar, if any is present, which contacts the probe is made visible on the probe due to the affinity of oils for the plastic and the propensity to spread as a thin film over the plastic surface. In addition, seven holes were cut in the ice and underlying sediments were agitated with a pole to observe a possible oil sheen.

There were no observances of coal tar or oil material in water or sediments through the efforts described above. Therefore, it is considered that coal tar contamination does not exist in the survey area, which is the most probable area in the river for this material to appear in relation to the former coal gasification plant.

As part of the December 1988 river inspection, two surface water and three sediment samples were collected and analyzed for PAHs. In addition, two water samples were collected in May 1990 and analyzed for PAHs. Sample locations are shown on Figure 3.1 presented previously. The water samples were collected from approximately 20 cm above the river bottom.

Analytical results for sediment and water samples are contained in Tables 5.9 and 5.10, respectively. Sediment samples S-1 and S-2 were collected within the river inspection area. These samples contain low concentrations of various PAHs. The total concentrations of PAHs in these samples were 4.42 ppm in S-1, 4.16 ppm in S-1 duplicate and 1.93 ppm in S-2. Sediment sample S-3 was collected upstream of the survey area and just downstream of a storm outfall pipe. The total concentration of PAHs in this sample was 5.66 ppm. The concentrations of PAHs at all three sampling locations are similar.

Sample S-3 is considered to be representative of background conditions in the Grand River near the property. The boreholes drilled during the geotechnical investigation adjacent to the area of sample S-3 (i.e. BH205, 206, 207) did not encounter any coal tar deposits based on

TABLE 5.9

ANALYTICAL RESULTS OF GRAND RIVER SEDIMENT SAMPLES

Compound (ppm)	*MDL*	*S-1*	*S-1 (Dup)*	*S-2*	*S-3*
Acenaphthene	0.02	ND	ND	0.02	0.02
Acenaphthylene	0.02	ND	ND	ND	ND
Anthracene	0.02	0.03	0.06	0.03	0.1
Benz(a)Anthracene	0.02	0.3	0.3	0.1	0.2
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	0.02	1.0	0.9	0.4	1.1
Benzo(a)Pyrene	0.02	0.5	0.4	0.1	0.7
Benzo(g,h,i)Perylene	0.04	0.2	0.3	0.1	0.4
Chrysene	0.02	0.6	0.5	0.1	0.5
Dibenz(a,h)Anthracene	0.04	0.09	0.1	TR	0.1
Fluoranthene	0.02	0.6	0.6	0.4	0.9
Fluorene	0.02	ND	ND	ND	0.04
Indeno(1,2,3-cd)Pyrene	0.04	0.2	0.2	0.08	0.3
Naphthalene	0.02	ND	ND	ND	ND
Phenanthrene	0.02	0.3	0.2	0.2	0.5
Pyrene	0.02	0.6	0.6	0.4	0.8

Notes:

ND - Not Detected
TR - Trace
MDL - Method Detection Limit

TABLE 5.10

ANALYTICAL RESULTS OF GRAND RIVER WATER SAMPLES

Compound (µg/L)	*MDL (1)*	*W-1*	*W-2*	*MDL (2)*	*W-3*	*W-4*
Acenaphthene	0.05	ND	ND	1.2	ND	ND
Acenaphthylene	0.05	ND	ND	1.5	ND	ND
Anthracene	0.05	ND	ND	2	ND	ND
Benz(a)Anthracene	0.05	ND	ND	2	ND	ND
Benzo(b)Fluoranthene and Benzo(k)Fluoranthene	0.05	0.06	ND	4	ND	ND
Benzo(a)Pyrene	0.05	ND	ND	3	ND	ND
Benzo(g,h,i)Perylene	0.1	ND	ND	5	ND	ND
Chrysene	0.05	ND	ND	2	ND	ND
Dibenz(a,h)Anthracene	0.1	ND	ND	NA	NA	NA
Fluoranthene	0.05	0.06	ND	2	ND	ND
Fluorene	0.05	ND	ND	1.5	ND	ND
Indeno(1,2,3-cd)Pyrene	0.1	ND	ND	NA	NA	NA
Naphthalene	0.05	ND	ND	1.2	ND	ND
Phenanthrene	0.05	ND	ND	2	ND	ND
Pyrene	0.05	ND	ND	1.5	ND	ND
Dibenz (a,h) Anthracene and Indeno (1,2,3-cd)Pyrene	NA	NA	NA	8	ND	ND

Notes:

ND - Not Detected
NA - Not Applicable
(1) Method Detection Limit for samples W-1 and W-2
(2) Method Detection Limit for samples W-3 and W-4

visual and olfactory observations. It would be expected that PAHs would be found in the river sediments because of the developed nature of the area and the many potential sources of PAHs in a developed area. A study of typical concentrations of PAHs in the environment by the MOE (5) indicated the presence of benzo (a) pyrene in soils and sediments near a highway at 2 ppm. It would be expected that similar concentrations may be encountered near roadways in the watershed of the Grand River. These sediments would then be expected to migrate to the river. Therefore, the concentration of PAHs found in the Grand River sediment samples could be expected to result from background activities.

The water sample collected in December 1988 adjacent to the former coal gasification plant (just upstream of sediment sample location S-2) showed two detections; benzo(b)fluoranthene/benzo(k)fluoranthene at 0.06 µg/L and fluoranthene at 0.06 µg/L. These values are slightly above the detection limit of 0.05 µg/L. These compounds were also detected in all three sediment samples which were analyzed. It is possible that these compounds were present in the water sample as a result of suspended sediments containing PAHs. The sediments may have become suspended by the movement of the diver.

The water sample collected in May 1990 adjacent to the former coal gasification plant did not contain detectable quantities of PAHs. This sample was collected without any agitation of sediments. These results may be more indicative of the water quality in the Grand River near the former coal gasification plant than the earlier results.

PAHs were not detected in the water samples which were collected in December 1988 and May 1990 upstream of the former coal gasification plant.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the information presented in this report, the following conclusions are made:

1) The material underlying the former coal gasification plant includes concrete and soil containing coal tar residues. Gasoline and diesel fuel odours are also noted in this area.

2) Coal tar residues are present in soil to the west of the former coal gasification plant. These residues are found sporadically and may have been placed in part during historical filling along the edge of the Grand River.

3) Coal tar residues are present in soil beneath the GRCA flood control berm.

4) The coal tar residues are generally found in the saturated soils and represent a potential source of groundwater contamination.

5) Groundwater flow on the property appears to be approximately parallel to the Grand River and toward the south.

6) Groundwater at the southern end of the property does not exhibit contamination by PAHs. One monitoring well exhibits low

concentrations of VOCs. The VOC contamination has various potential sources, including the coal tar residues and former automobile service stations in the area.

7) Coal tar residues have not migrated to the southern property boundary as evidenced by the absence of PAHs in soil and groundwater at the two monitoring wells at the boundary.

8) Coal tar residues are not visually present in the bed of the Grand River adjacent to the former coal gasification plant.

9) Water and sediment in the Grand River does not exhibit a detectable impact by PAHs from the former coal gasification plant.

6.2 RECOMMENDATIONS

Based on the above, the following recommendations are made:

1) Any proposed disturbance of the area containing coal tar residues should be reported in writing to the MOE, Waste Management Branch prior to commencement and conducted in accordance with applicable regulations and guidelines.

2) A monitoring program should be implemented in the short term to assess the potential migration of contaminants in groundwater and surface water. This would include:

i) measuring water levels in the monitoring wells and the Grand River quarterly for one year;

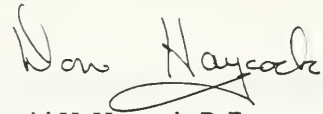
ii) collecting water samples from wells which do not contain coal tar and from two locations in the Grand River on a semi-annual basis for one year (groundwater samples would be analyzed for PAHs and VOCs, surface water samples would be analyzed for PAHs); and

iii) reporting all results to the MOE.

The need for monitoring would be re-assessed at the end of the one year period.

All of Which is Respectfully Submitted,

CONESTOGA-ROVERS & ASSOCIATES



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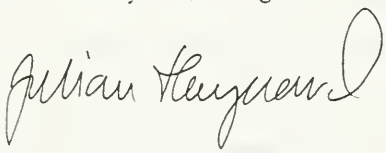

Julian Hayward, P. Eng.

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APPENDIX A

GRAND RIVER INSPECTION REPORT
BY INTEGRATED EXPLORATIONS

DIVING INSPECTION OF COAL TAR SITE IN THE GRAND RIVER, CAMBRIDGE (GALT), ONTARIO

Report No. PJ8818-1

December 29, 1988

REPORT PREPARED BY -

Al Melkic,

DIVING INSPECTION OF COAL TAR SITE IN THE GRAND RIVER, CAMBRIDGE (GALT), ONTARIO

INTRODUCTION

On December ~~15~~ 16. 1988, Integrated Explorations conducted an underwater inspection of the area suspected of harbouring coal tar in the Grand River. The site was adjacent to the area known as the "Mill Race on the Grand", and located on the east bank, south of the Samuelson railway bridge in Cambridge (Galt). The purpose of the dive was to survey an area bounded by a 50 by 50 meter square for signs of coal tar using visual and coal tar probing methods. Some representative samples of water and sediment were also collected from the area.

Those involved in the project included the following: Mr. Julian Hayward who directed the survey, Mr. Al Melkic, who supervised the dive team and acted as stand by diver, Mr. Yves Rollin who worked as our primary diver, and Mr. Christopher Wade who functioned as the dive tender. Also, various OMOE officials dropped in briefly to observe our survey operation.

SITE OBSERVATIONS

1 - AREA SURVEYED is illustrted in the attached survey plan. It was bounded by a 50 by 50 meter square. As illustrated in our drawing, the diver conducted an intensive search near shore and a looser but more extensive search as he proceeded towards the middle of the river. This is a standard procedure as contaminants entering rivers from the land are usually found close to shore.

2 - DIVING CONDITIONS included ice cover of 4 to 6 inches and two feet visibility. Observations made by the diver were relayed to the surface crew. Ice holes were cut in strategic places to allow the diver to verify his position with respect to surface transect lines which were layed out over the surface of the ice.

3 - TAR PROBING TECHNIQUE was used to aid visual inspection as buried coal tar is difficult to distinguish from silt and clay. Technical notes pertaining to the coal tar probing methodology are appended to this report.

4 - PRESENCE OF COAL TAR was not indicated anywhere in our survey. Our experience from other coal tar surveys would lead us to believe that there is no coal tar present in the area. It should be noted that even if coal tar is hidden beneath superficial sediments, the movement of the diver and his umbilical line combined with the continual probing of the sediments would be sufficient to reveal such deposits.

5 - RIVER SUBSTRATE was characterized by cobbles and boulders within 5 to 7 meters from shore. These were covered with a light silt varying between 0 to 15 cm in thickness. Further out from shore where the depth approached 6 ft. the bottom substrate changed to between 2 1/2 and 5 cm of silt cover over gravel with a clay substrata. Some areas were encountered where the tar probe could be pushed 36 cm into the soft sediment.

6 - SEDIMENT AND WATER SAMPLES were collected at points depicted in the survey sketch map attached to this report. The two water samples were collected at a height of 20 cm from the river bottom. The three sediment samples were collected by scraping material directly into the sampling jars.

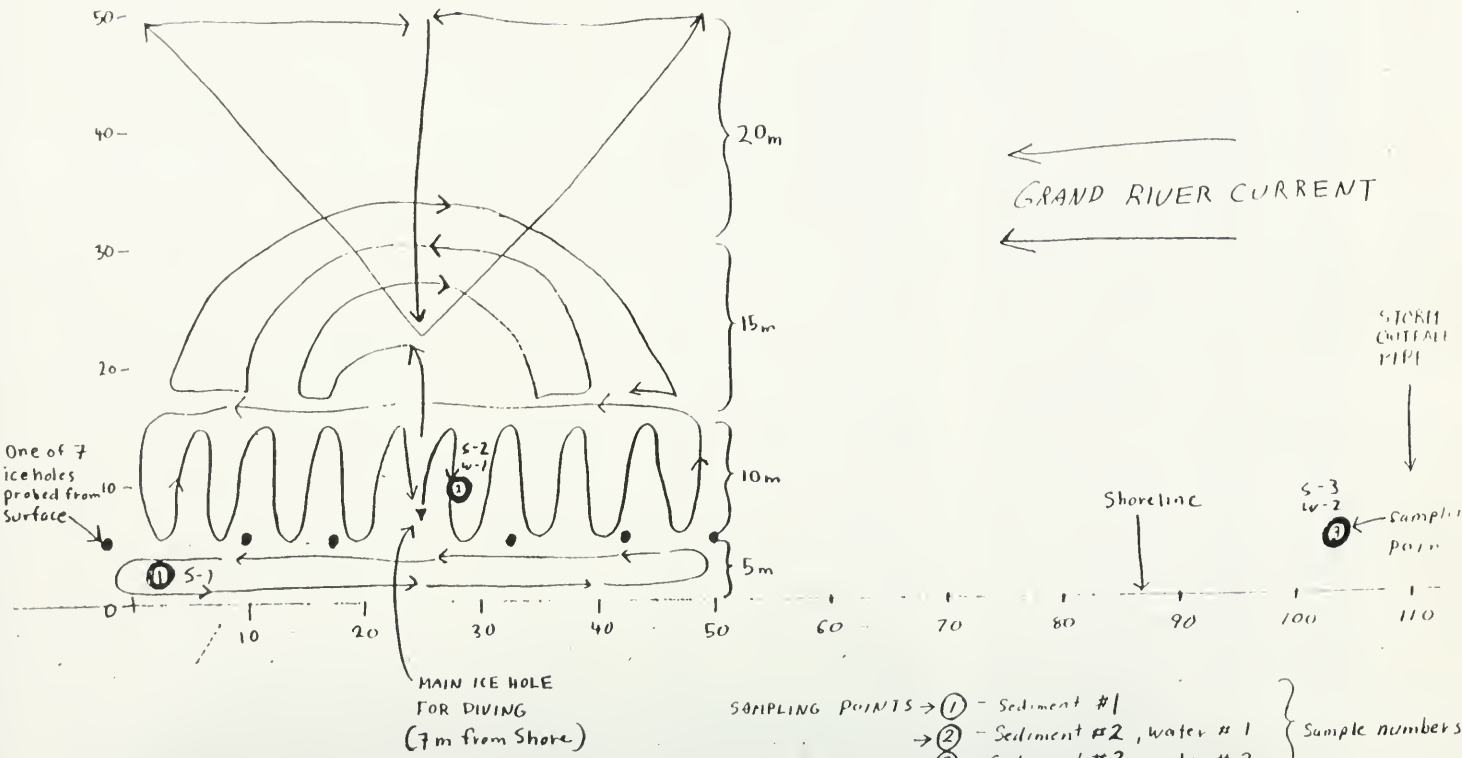
Technical Notes Regarding Novel Tar Probing Technology

Integrated Explorations has developed a number of techniques for quickly estimating the extent of underwater coal tar deposits without resorting to costly chemical analysis. Some of these techniques were used to develop the first map delineating the coal tar spill site in the Rideau River in 1986. This methodology was later improved upon and used with great success at the Port Stanley site in 1987. Currently the probing technique is being used in the Trent River to explore for creosote contamination in outlying areas for the Kingston Regional MOE. In February of 1989 our firm will be using this probing method to delineate the extent of a coal tar contaminated site in Owen Sound for the London Regional Ministry of the Environment.

With this method, oily and tar-like substances occurring as minute specks are made visible by virtue of their affinity for the plastic probe and their propensity to spread as a thin film over such surfaces. This provides a distinct advantage in detecting tiny specks covered by sediments. It also makes it easier to spatially resolve contaminated areas by providing a large number of visual indications per unit area without having to retrieve actual samples except for verification. With this technique, a diver can also distinguish between tar-like substances and clay which in our experience has always presented difficulties underwater.

DIVER SEARCH PATTERNS USED AT GALT SITE DEC. 16th, 1988

(UNDER ICE DIVE)



SAMPLING POINTS → (1) - Sediment #1
→ (2) - Sediment #2, water # 1
→ (3) - Sediment #3, water # 2

} Sample numbers

APPENDIX B

FIELD METHODS FOR PHASE IV INVESTIGATION

1.0 FIELD INVESTIGATION

The Phase IV field investigation program was conducted during the period of February 5, 1990 to May 3, 1990. This program consisted of the installation of three groundwater monitoring wells, completion of five soil boreholes, soil sampling of the groundwater monitoring wells and soil boreholes, monitoring of water levels at four groundwater monitoring well locations and two river level stations, groundwater and river water sampling and level surveying of the installed groundwater monitoring wells and soil boreholes. A detailed description of these tasks follows.

1.1 GROUNDWATER MONITORING WELL INSTALLATION

The firm of Strata Drilling Incorporated of Cambridge, Ontario, was retained by CRA to install three groundwater monitoring wells; OW14-90, OW15-90 and OW17-90 (Figure 3.1, previous). The boreholes were advanced utilizing a CME-55 truck-mounted drill rig equipped with 4-1/4 inch I.D. hollow stem augers. During the course of the drilling operation split-spoon samples of the soils were collected at 2.5 foot intervals in order to assess the stratigraphic sequences at each of the boreholes. The soil samples were examined and the descriptions logged by a qualified CRA technician. Blow counts for Standard Penetration Tests (SPT) were also recorded during the soil sampling event. The recovered soil samples were labeled as to sample interval and location and retained for future reference.

Once the desired borehole depth had been achieved, groundwater monitoring wells were installed into the borehole. Construction of the groundwater monitoring wells consisted of a 4.0 foot length of #10 slot, 2 inch diameter, stainless steel well screen connected by coupled 2 inch diameter black iron riser pipe. Construction details for the groundwater monitoring wells installed during the Phase IV investigation are provided in Table B-1.

The groundwater monitoring well installations were completed with a native sand pack caved to a minimum height of 2.0 feet above the top of the screen. The remaining annular space was filled with a mixture of cuttings and bentonite grout to within 2.0 feet of the surface which was subsequently filled with concrete. A protective steel casing was placed over the groundwater monitoring well and set into the concrete to complete the installation.

1.2 SOIL BOREHOLES

The firm of Strata Drilling Incorporated was also retained by CRA to complete five soil boreholes; BH16-90, BH18-90, BH19-90, BH20-90 and BH21-90 (Figure 3.1, previous). Each of these boreholes was advanced to the desired depth utilizing the equipment and methods employed during the installation of the groundwater monitoring wells. As previously, during the course of the drilling operations, split-spoon samples of the soils were collected at 2.5 foot intervals in order to assess the stratigraphic sequences at each of the boreholes. The retrieved soil samples were examined and the

TABLE B-1

MONITORING WELL COMPLETION DETAILS

Well Number	*Ground Elevation (m AMSL)*	*Reference Elevation (m AMSL)*	*Total Depth (m)*	*Screened Interval*		*Screened Material*
				Elevation (m AMSL)	*Depth (m)*	
OW14-90	267.541	268.409	5.79	263.84 - 262.62	4.57 - 5.79	sand
OW15-90	267.639	268.542	5.49	264.27 - 263.05	4.27 - 5.49	sand
OW17-90	268.484	269.560	5.83	264.95 - 263.73	4.61 - 5.83	sand

descriptions logged by a qualified CRA technician. Blow counts for Standard Penetration Tests (SPT) were also recorded during the soil sampling events. The recovered soil samples were labeled as to the sample interval and location and retained by CRA for future reference.

Upon completion of the borehole to the desired depth, the borehole was backfilled using only clean cuttings. The remaining annular space was then grouted using a bentonite grout to within 2.0 feet of the surface, which was subsequently filled with concrete to provide a good surface seal.

In order to prevent any form of cross-contamination from borehole to borehole, the drilling rig and all equipment was washed using a high pressure, hot water (steam) washer. The wash water was collected in a trough and pumped to 45 gallon drums for future disposal.

1.3 SOIL SAMPLING

During the course of the drilling operations for the groundwater monitoring wells and the soil boreholes, soil samples were collected at 2.5 foot intervals, using split-spoon sampling techniques. The recovered soil samples were examined and the descriptions logged by a qualified CRA technician. The soil samples were retained in precleaned laboratory glass jars and labeled as to the sample interval and location. Soil samples selected for laboratory analysis were packed on ice in a secure chest

and shipped via courier to the contract laboratory. Chain-of-Custody forms accompanied each shipment.

In order to prevent any cross-contamination between successive soil samples and prior to taking of the first soil sample, the split-spoon sampling device was cleaned using a clean water wash followed by a distilled water rinse, a methanol rinse and a final distilled water rinse.

1.4 GROUNDWATER SAMPLING

Prior to groundwater sampling, each groundwater monitoring well was developed by removing a minimum of five standing well volumes of groundwater from the well using a Wattera pump and polytubing set within the well casing. Stabilization criteria were met when two consistent measurements of pH and conductivity were recorded. Observations of color, turbidity and odor were also noted during the well development and are presented in Table B-2 along with the aforementioned development criteria.

Once the groundwater monitoring wells had been suitably developed, two groundwater samples were collected from each of the wells. The first sample, for Volatile Organic Compounds (VOC), was collected in a 40-ml laboratory glass vial. A second sample, for Polynuclear Aromatic Hydrocarbons (PAH), was collected in a 1-litre amber glass container. All samples were assigned a unique sample number, packed on ice in a secure

TABLE B-2

WELL DEVELOPMENT AND STABILIZATION PARAMETERS

Well Number	*Well Volume (L)*	*Volume Removed (L)*	*pH*	*Conductivity (umhos/cm)*	*Clarity*	*Colour*	*Odour*	*Comments*
OW14-90	4.0	9.0	6.0	1020	very turbid	brown	none	moderate recharge
		4.0	6.3	1020	very turbid	brown	none	moderate recharge
		4.0	6.4	1020	very turbid	brown	none	moderate recharge
		4.0	6.4	1020	very turbid	brown	none	moderate recharge
OW15-90	3.0	4.5	6.67	920	very turbid	dark grey	none	contains silty sands
		2.0	6.67	920	very turbid	dark grey	none	contains silty sands
		3.0	7.07	920	very turbid	dark grey	none	contains silty sands
OW17-90	2.0	3.0	6.7	1020	very turbid	black	moderate coal tar	sheen, moderate recharge
		3.0	6.7	1040	very turbid	black	moderate coal tar	sheen, moderate recharge
		3.0	6.6	1040	very turbid	grey	moderate coal tar	sheen, moderate recharge
		3.0	6.6	1040	very turbid	grey	moderate coal tar	sheen, moderate recharge

chest and shipped via courier to the contract laboratory. A chain-of-custody form accompanied the shipment of samples.

1.5 RIVER WATER SAMPLING

Water samples from the Grand River were collected on May 3, 1990, at two locations, approximately 20 cm above the river bed. The method employed in order to retrieve the river water samples consisted of securing a rubber stopper sealed, 1-litre, amber glass bottle to a long pole with tape. The bottle was then placed into the river, approximately 10 feet from shore, such that the bottle was upright and the base of the bottle rested on the river bed. The rubber stopper was then removed allowing the bottle to fill. The retrieved sample was then assigned a unique sample number, packed on ice in a secure chest and shipped via courier to the contract laboratory. A chain-of-custody form accompanied the shipment.

1.6 WATER LEVEL MONITORING

During the course of the Phase IV investigation, groundwater elevations were measured in groundwater monitoring wells; OW8-87, OW14-90, OW15-90 and OW17-90 on several occasions (see Table 4.1, previous). The water levels were obtained using a Solinst water level indicator which emits an audible signal when the probe comes in contact with the water surface. The probe is attached to a flat embossed tape, calibrated to 1 cm intervals, which allows for accurate water level readings to

within 2 mm. In order to avoid any cross-contamination between groundwater monitoring wells and prior to the first reading, the stainless steel probe was washed with a methanol and distilled water rinse.

1.7 LEVEL SURVEY

In order to establish horizontal and vertical control, CRA conducted a level survey of the groundwater monitoring wells and boreholes in February 1990. The reference and ground elevations are included on the stratigraphic and instrumentation logs in Appendix C.

1.8 SINGLE WELL RESPONSE TESTS

Single well response tests were conducted on two groundwater monitoring wells; OW14-90 and OW15-90. The method employed in the tests involved displacing the groundwater within the well casing with a slug of known volume and monitoring the water levels, over time, as they returned to the static level. The recorded date was then analyzed following methods outlined by Hvorslev (1951) to determine the hydraulic conductivity.

APPENDIX C

BOREHOLE LOGS

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO 200 SIEVE SIZE)	GRAVELS MORE THAN HALF COARSE FRACTION LARGER THAN NO 4 SIEVE SIZE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, < 5% FINES
			GP	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, < 5% FINES
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES > 12% FINES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES > 12% FINES
	SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS, < 5% FINES
			SP	POORLY-GRADED SANDS, OR GRAVELLY SANDS, < 5% FINES
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES > 12% FINES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES > 12% FINES
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
			OH	ORGANIC CLAYS OF HIGH PLASTICITY

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-7)

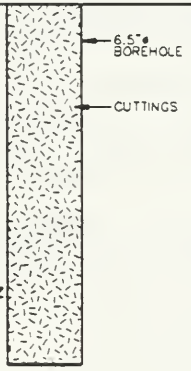
PROJECT NAME: FORMER GALT GAS CO SITE — HOLE DESIGNATION: BH1-87

PROJECT NO.: 2087 — DATE COMPLETED: MARCH 16, 1987

CLIENT: MILLRACE ON THE GRAND INC. — DRILLING METHOD: SOLID AUGER

LOCATION: AS PER PLAN — CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE TYPE
	GROUND SURFACE	268.43				
	CONCRETE FLOOR SLAB	268.03				
1.0	GW GRAVEL (Fill): some sand, maximum aggregate size: 20 mm dia., compact, brown, moist	267.23				
2.0	SM SAND (Fill): some silt, little gravel, poorly graded, medium grained, dense, brown, moist	266.23				
3.0	SM SAND: some silt, poorly graded, medium grained, dense, brown, moist					
4.0	- becomes water saturated with occasional thin seams of coorse SP.	264.43				
5.0	END OF HOLE @ 4.90 m BGS.	263.53				
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-8)

PROJECT NAME: FORMER GALT GAS CO SITE
HOLE DESIGNATION: BH2-87

PROJECT NO.: 2087
DATE COMPLETED: MARCH 16, 1987

CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: 95mm ID HSA

LOCATION: AS PER PLAN
CRA SUPERVISOR: B FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE VALUE
	GROUND SURFACE	268.44				
	CONCRETE FLOOR SLAB	268.04	200mm ø BOREHOLE			
	GW GRAVEL (Fill): some sand, compact, brown, moist					
1.0	SM SAND (Fill): some silt, trace clay, fine grained, compact, brown, moist	267.44	CUTTINGS	1SS		10
2.0	SM SAND: some silt, layered, dilatent, low to non-plastic, compact, brown, moist, occasional layer of medium grained SP	266.64		2SS		14
				3SS		55
3.0	SP SAND: trace silt, trace fine gravel, layered, medium grained, very dense, brown, moist	265.44		4SS		28
4.0	SP SAND: uniform, layered, becomes grey, water saturated - strong coal tar odour	264.44		5SS		26
		263.84 ▽				
5.0	END OF HOLE @ 5.20 m BGS.	263.24		6SS		18
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-9)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 2087
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH-3-87
DATE COMPLETED: MARCH 16, 1987
DRILLING METHOD: 95mm I.D. HSA
CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE VALUES
	GROUND SURFACE	267.06				
	CONCRETE FLOOR SLAB	266.66	6.5" ø BOREHOLE			
1.0	GW GRAVEL (Fill): some sand, compact, brown, moist, becomes black with occasional coal fragments	265.66	CUTTINGS	1SS	X	28
2.0	SP SAND: trace silt, layered, fine grained, dense, brown, moist, becomes siltier, water saturated - thin seam of fine SM, black - grey, strong coal tar odour	264.76 ▽		2SS	X	25
3.0				3SS	X	29
	- brown/yellow with strong gasoline odour			4SS	X	25
4.0	END OF HOLE @ 3.90 m BGS.	263.16				
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE — HOLE DESIGNATION: BH-4-87

PROJECT NO.: 2087 — DATE COMPLETED: MARCH 16, 1987

CLIENT: MILLRACE ON THE GRAND INC. — DRILLING METHOD: 95mm D HSA

LOCATION: AS PER PLAN — CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE VALUE
	GROUND SURFACE	267.04				
	CONCRETE FLOOR SLAB	266.64	6.5" ø BOREHOLE			
1.0	GW GRAVEL (Fill): some sand, occasional coal fragments, bricks and other rubble, loose, brown to black, moist	265.64	CUTTINGS	1SS		20
2.0	SW-SM SAND (Fill): some gravel, some silt, some flyash, occasional pebbles, wood fragments, slag, compact, white to brown, moist	264.76		2SS		37
	SM SAND: some silt, poorly graded, fine to medium grained, compact, brown, water saturated	264.64		3SS		4
3.0	- grey/black, strong coal tar odour	263.99		4SS		6
4.0	SP SAND: some gravel, medium to coarse grained, compact, grey to yellow, water saturated, strong gasoline odour	263.24				
	END OF HOLE @ 3.80 m BGS.					
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 2087
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH-5-87
DATE COMPLETED: MARCH 17, 1987
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	266.59				
	CONCRETE FLOOR SLAB	266.19	6.5" ø BOREHOLE			
	GW GRAVEL (Fill): some sand, compact, brown, moist	265.79				
1.0	SM SAND (Fill): some silt, little gravel, occasional brick fragments and other rubble, loose, brown to red, dry	265.19	CUTTINGS	1SS		9
2.0	SM SAND: some silt, fine grained, uniform, dilatent, layered, oxidized seams, compact, light brown, water saturated	264.19 ▽		2SS		13
				3SS		24
3.0	- thin seam gravel SG					
				4SS		18
4.0	- thin seam gravel SG	262.39		5SS		46
	END OF HOLE @ 4.20 m BGS.					
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: BH6-87

PROJECT NO.: 2087
DATE COMPLETED: MARCH 17, 1987

CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: SOLID AUGER

LOCATION: AS PER PLAN
CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE TYPE
	GROUND SURFACE	267.04				
	CONCRETE FLOOR SLAB	266.64				
	GW GRAVEL (Fill): some sand, occasional pebbles, coal fragments, compact, black, moist.	266.34				
1.0	SG SAND: some gravel, some silt, medium grained, compact, light brown, dry.	265.54				
	CONCRETE SLAB	265.24				
2.0	ML SILT some sand, fine grained, cohesive, black, water saturated.	264.94				
	SM SAND: some silt, trace clay, trace gravel, medium grained, grey/black, water saturated, strong coal tar odour.	264.54				
3.0	END OF HOLE @ 2.50 m BGS.					
4.0						
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

200mm ø BOREHOLE

CUTTINGS CAPPED WITH BENTONITE PELLETS

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼ (16/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-13)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: BH7-87

PROJECT NO.: 2087
DATE COMPLETED: MARCH 17, 1987

CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: 95mm O HSA

LOCATION: AS PER PLAN
CRA SUPERVISOR: B. FEDY

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	268.05				
	SM TOPSOIL: organic, black, moist	267.65				
1.0	SM SAND (Fill): sand, some silt, occasional coal fragments and rubble, trace flyash and slag, fine grained, loose, brown to yellow, dry, coal smell		6.5" ø BOREHOLE	1SS		14
2.0	– moist, dilatent, compact, coal tar odour		CUTTINGS	2SS		15
3.0	SM SAND: some silt, uniform, fine grained, dilatent, layered, oxidized seams, compact to dense, light brown, very moist	265.45		3SS		17
		265.05	▽			
4.0	– water saturated – thin seam of CL, some silt, firm			4SS		16
	END OF HOLE @ 4.40 m BGS.	263.65		5SS		12
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼ (17/03/87)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(1-01)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: OW8-87

PROJECT NO.: 2087
DATE COMPLETED: April 20, 1987

CLIENT: MILL RACE ON THE GRAND INC
DRILLING METHOD: 108mm I.D. H.S.A.

LOCATION: AS PER PLAN
CRA SUPERVISOR: P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE		
				SAMPLE NUMBER	SAMPLE TYPE	N VALUE
	REFERENCE ELEVATION (Top of riser) GROUND ELEVATION	269.178 268.16	LOCKING CAP			
1.0	SM – SAND AND SILT (FILL), some gravel, poorly sorted, loose, brown, moist.		50 mm ø B.I.P. PIPE 200mm ø BOREHOLE	1SS		8
				2SS		7
2.0	– void 2.27m to 2.59m		CEMENT GROUT	3SS		12
3.0	SP – SAND, some gravel, loose, poorly graded, medium grained, brown, water saturated, weak coal tar odour.	265.26 264.81	▽	4SS		4
				5SS		14
4.0	– very loose, black, sample is coal tar saturated, strong coal tar odour, split spoon coated in a coal tar water mix, HNU reading downhole 6.8ppm.		BENTONITE PELLET SEAL	6SS		4
5.0	– fine grained, poorly graded, loose, sand grains black, sample saturated with coal tar		SAND PACK	7SS		2
6.0	CL – CLAY, some silt, soft, massive, low plastic, brown, moist, coal tar found as streaks and blebs throughout sample	262.52 262.06	WELL SCREEN	8SS		8
7.0	END OF HOLE AT 6.1 m B.G.S.		SCREEN DETAILS: Screened Interval: 5.18 m to 6.1 m AMSL Length – .91 m Diameter – 50 mm Slot # 10 Material– Stainless Steel			
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(...-02)

PROJECT NAME: FORMER GALT GAS CO SITE — HOLE DESIGNATION: BH-9-87

PROJECT NO.: 2087 — DATE COMPLETED: Apr 20, 1987

CLIENT: MILLRACE ON THE GRAND INC. — DRILLING METHOD: 108mm I.D. H.S.A.

LOCATION: AS PER PLAN — CRA SUPERVISOR: P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE 'N' VALUE
	GROUND SURFACE	267.04				
	Concrete Floor Slab	266.94	200mm ø BOREHOLE	1SS	SS	4
1.0	GW - SAND AND GRAVEL (FILL), some red brick fragments, poorly sorted, cohesionless, very dense, brown, moist	266.08	AUGER CUTTINGS	2SS	SS	35
	-slight coal tar odour					
2.0	-very dense zone, probable concrete side wall of buried tank?	265.24				
3.0	Refusal - END OF HOLE AT 1.8m B.G.S. - hole backfilled to surface with auger cuttings					
4.0						
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-03)

PROJECT NAME: FORMER GALT GAS CO SITE — HOLE DESIGNATION: BH10-87

PROJECT NO.: 2087 — DATE COMPLETED: Apr 2", 1987

CLIENT: MILL RACE ON THE GRAND INC — DRILLING METHOD: 108mm I.D. H.S.A.

LOCATION: AS PER PLAN — CRA SUPERVISOR: P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE N VALUE
	GROUND SURFACE	267.04				
	Concrete Floor Slab	266.94				
	SM – SAND AND SILT (FILL), some gravel, loose, massive, dark brown, moist.	266.24		1SS		6
1.0	SP – SAND, little gravel, poorly graded, compact, medium grained, brown, moist,			2SS		3*
2.0	–water saturated	264.76	▽ 200mm ø BOREHOLE	3SS		19
	–black film and liquid on sand grains, iridescent sheen, strong diesel odour		CEMENT GROUT	4SS		17
3.0	–slight diesel odour, greyish white sands			5SS		13
4.0	–black, coal tar saturated, strong coal tar odour, PID reading downhole 2 ppm			6SS		3*
	SM – SAND, some silt, little clay, compact, fine grained, massive, brown, water saturated	262.32		(7SS)		13
5.0						
	GM – GRAVEL, some silt, some sand, some shaley limestone fragments, well graded, dense, light brown, water saturated	261.25		8SS		3*
6.0				9SS		48
7.0	Auger Refusal, END OF HOLE AT 7.16 m B.G.S. on probable bedrock	259.88		10SS		63
8.0	BOREHOLE GROUTED TO SURFACE UPON COMPLETION					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE — HOLE DESIGNATION: BH11-87
PROJECT NO.: 2087 — DATE COMPLETED: Apr 21, 1987
CLIENT: MILL RACE ON THE GRAND INC. — DRILLING METHOD: 108mm I.D. H.S.A.
LOCATION: AS PER PLAN — CRA SUPERVISOR: P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (mm)
	GROUND SURFACE	267.04				
	Concrete Floor Slab	266.94				
	GW – SAND AND GRAVEL (FILL), compact, well graded, whitish brown, slightly moist.			1SS		–
1.0				2SS		25
		265.52	200mm ø BOREHOLE			
2.0	Concrete Slab			NO SAMPLE		
		264.91				
	SP – SAND, trace silt, loose to compact, poorly graded, medium grained, mottled brown black, water and diesel saturated, strong diesel odour	264.75	CEMENT GROUT	3SS		17
3.0	– trace gravel			4SS		11
4.0	– iridescent sheen to samples, strong diesel odour, downhole HNU 10ppm			5SS		23
5.0		262.02		6SS		8
	ML – SILT, some sand, little clay, very fine grained, compact, massive, brown, water saturated	261.89		7SS		28
6.0						
	GM – GRAVEL, some silt, some sand, some shaley limestone fragments, well graded, dense, grey brown, water saturated			8SS		60
7.0		260.03		9SS		100+
	Auger Refusal, END OF HOLE AT 7.01m B.G.S. on probable bedrock					
8.0	BOREHOLE GROUTED TO SURFACE UPON COMPLETION					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(-05)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO. 2087
CLIENT MILL RACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION BH12-87
DATE COMPLETED. Apr. 22, 1987
DRILLING METHOD. 108mm I.D. H.S.A.
CRA SUPERVISOR. P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE N VALUE
	GROUND SURFACE	267.05				
	Concrete Floor Slab	266.95		1SS		9
1.0	SW – SAND (FILL), some gravel, some red brick fragments, well graded, loose, brown, moist, no chemical odour			2SS		5
		265.53				
2.0	SP – SAND, little gravel, medium grained, loose, massive, poorly graded, brown, moist, slight diesel odour, water saturated at 2.13m –black film coating sand grains, strong diesel odour	264.95	▽ 200mm ø BOREHOLE	3SS		8
			CEMENT GROUT	4SS		26
3.0						
	–slight diesel odour			5SS		13
4.0		262.84		6SS		16
	ML – SILT AND SAND, some clay, very fine grained, poorly graded, massive, firm, light brown.					
5.0		262.02		7SS		28
	GM – GRAVEL, some silt, some sand, dense, well graded, brown, water saturated					
		261.42				
6.0	Auger Refusal, END OF HOLE AT 5.63m B.G.S. on possible bedrock					
7.0	BOREHOLE GROUTED TO SURFACE UPON COMPLETION					
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-06)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: BH-13-87

PROJECT NO.: 2087
DATE COMPLETED: April 23, 1987

CLIENT: MILL RACE ON THE GRAND INC.
DRILLING METHOD: 108mm I.D. H.S.A.

LOCATION: AS PER PLAN
CRA SUPERVISOR: P. HAYES

DEPTH m BG	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	268.34				
	Asphalt	268.28				
	SW – SAND (FILL), little gravel, well graded, loose, massive, brown, moist.					
1.0						
2.0			200mm ø BOREHOLE	1SS		9
3.0			CEMENT GROUT	2SS		5
		264.67				
4.0	SP – SAND, loose, massive, medium grained brown, water saturated	264.52		3SS		8
	–greyish black sands, faint coal tar odour					
5.0	–black, coal tar staining on sand grains, moderate coal tar odour			4SS		26
	–sample saturated with coal tar, sample HNU 100ppm			5SS		13
6.0		262.23				
	ML–SILT and SAND, some clay, massive, firm, light brown, saturated, coal tar found as stringers between clean silt and sand			6SS		16
		261.62				
7.0	GM–GRAVEL, some silt, some sand, dense, well graded brown, water saturated			7SS		28
		261.01				
	Auger Refusal, END OF HOLE AT 7.32m B.G.S. on possible bedrock					
8.0						
	BOREHOLE GROUTED TO SURFACE UPON COMPLETION					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: GW'4-90

PROJECT NO.: 2087
DATE COMPLETED: FEBRUARY 7, 1990

CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: 108mm ID HSA

LOCATION: AS PER PLAN
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	N VALUE
	REFERENCE ELEVATION (Top of Riser)	268.409				
	GROUND ELEVATION	267.54				
	OL(TOPSOIL)	267.39	CONCRETE			
1.0	SW(SAND)FILL, some sand, little gravel, fine to medium grained, well graded, very dense, brown, moist		BENTONITE GROUT			
2.0			203mmø BOREHOLE			
3.0						
		264.46				
		263.73	BENTONITE PELLET SEAL			
4.0	SW(SAND), some sand, little gravel, trace to little silt, fine to coarse grained, well graded, very dense, brown	263.73	SAND PACK	1SS		48
			50.8mmø BLACK IRON PIPE			
5.0			WELL SCREEN			
6.0			CAVE	2SS		>50
7.0						
8.0				3SS		41
9.0						
	ML(SILT), trace to little sand, fine grained, dilatent, dense, brown, wet, no odour	258.4		4SS		37
10.0						
11.0				5SS		44
12.0			SCREEN DETAILS Screened Interval 4.57m to 5.79m BGS Length – 1.22m Diameter – 50.8mm Slot # 10 Material – Stainless Steel Sand pack interval: 3.72m to 5.79m BGS Material – Natural Sand			
	Auger refusal	255.2				
	END OF HOLE @ 12.34 m BGS.					
13.0						

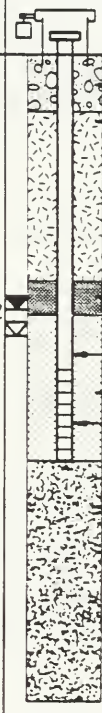
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (14/03/90)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO SITE
HOLE DESIGNATION: GW15-90
PROJECT NO.: 2087
DATE COMPLETED: FEBRUARY 6, 1990
CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: 108mm O HSA
LOCATION: AS PER PLAN
CRA SUPERVISOR: K VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	SAMPLE NUMBER	SAMPLE TYPE	N VALUE
	REFERENCE ELEVATION (Top of Riser)	268.54			
	GROUND ELEVATION	267.64			
	Asphalt	267.49			
1.0	SP(SAND)FILL, some sand, little gravel, trace silt, fine grained, poorly graded, cobbles, dense, brown/black, moist		1SS		25
2.0	Little to trace gravel, little silt, loose, brown		2SS		8
	Some sand, little silt, fine grained, loose, brown, moist		3SS		7
3.0	Same sand, little gravel, trace silt, fine grained, poorly graded, very dense, metal, brown, moist		4SS		50
		264.50 / 263.83			
4.0	SW(SAND), some sands, little to trace gravel, fine to coarse grained, well graded, dense, brown, wet, no odour	263.83	5SS		42
5.0	Little gravel, very dense		6SS		57
	SW-GW(SAND/GRAVEL), some sand, some gravel, fine to coarse grained, well graded, very dense, brown, wet	262.46	7SS		58
6.0			8SS		60
7.0					
	Cobbles		9SS		>50
8.0					
	Auger refusal	258.95			
9.0	END OF HOLE @ 8.69 m BGS.				
10.0					
11.0					
12.0					
13.0					



SCREEN DETAILS:
Screened interval:
4.27m to 5.49m BGS
Length - 1.22m
Diameter - 50.8mm
Slot # 10
Material - Stainless Steel
Sand pack interval:
3.51m to 5.49m BGS
Material - Natural Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (14/03/90)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
HOLE DESIGNATION: BH16-90
PROJECT NO.: 2087
DATE COMPLETED: FEBRUARY 8, 990
CLIENT: MILLRACE ON THE GRAND INC.
DRILLING METHOD: 108mm D HSA
LOCATION: AS PER PLAN
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE		
				NUMBER	TYPE	VALUE
	GROUND ELEVATION	268.20				
	OL(TOPSOIL)	268.05	CONCRETE			
1.0	SW(SAND)FILL, some sand, little gravel, fine to medium grained, well graded, dense, cobbles, moist		203mmø BOREHOLE			
2.0			BENTONITE GROUT			
3.0	Little silt, construction material, bricks, rocks, medium dense, brown, wet, no odour or product			1SS		22
		264.54				
4.0	Rocks			2SS		23
	Flyash, black, wood, wet, very slight coal tar odour, no product or sheen present			3SS		27
5.0				4SS		62
6.0		262.41				
	ML(SILT), little to trace sand, trace clay, fine to medium grained, brown/black, wet, slight coal tar odour, water discoloured	262.10		5SS		57
7.0	SW-GW(SAND/GRAVEL), some sand, some gravel, medium coarse grained, well graded, brown, very dense, wet, moderate coal tar odour			6SS		39
	Dense, moderate coal tar odour, no product	260.73				
8.0	END OF HOLE @ 7.47 m BGS.					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 2087
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: GW7-90
DATE COMPLETED: FEBRUARY 9, 1990
DRILLING METHOD: 108mm I.D. HSA
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE N VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND ELEVATION	269.560 268.484				
0	OL(TOPSOIL)	268.33	CONCRETE			
	SW(SAND)FILL, some sand, little gravel, fine to medium grained, dense, cobbles, brown, moist		BENTONITE GROUT			
1.0						
			203mmø BOREHOLE	1SS		4
2.0			BENTONITE PELLET SEAL			
			SAND PACK			
3.0						
			50.8mmø BLACK IRON PIPE	2SS		
		264.51 264.32				
4.0				3SS		20
	OL(SILT), trace fine sand, loose, black, wood chips, decayed vegetation, wet, slight coal tar odour	264.06				
5.0				4SS		5
	SW(SAND), some sand, little gravel, fine to coarse grained, well graded, medium dense, brown, slight coal tar odour, wet	263.3				
				5SS		>30
6.0						
	ML(SILT), trace fine sand, medium dense, brown, wet	262.08 261.93		6SS		>30
7.0	SW(SAND), some sand, little gravel, medium to coarse grained, well graded, medium dense, brown, wet, very slight coal tar odour	261.77				
	END OF HOLE @ 6.71 m BGS.					
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

SCREEN DETAILS:
Screened Interval:
4.61m to 5.83m BGS
Length – 1.22m
Diameter – 50.8mm
Slot # 10
Material – Stainless Steel
Sand pack interval:
2.44m to 6.71m BGS
Material – Natural Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE: REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (14/03/90)

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(1-01)

PROJECT NAME: FORMER GALT GAS CO SITE
PROJECT NO.: 3318
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH18-90
DATE COMPLETED: FEBRUARY 9, 1990
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND ELEVATION	268.16				
	SW(SAND)FILL, little gravel, trace silt, medium coarse grained, well graded, loose, brown, moist, no odour		CONCRETE SURFACE SEAL			
2.5	Little silt, loose, dark brown, wet, no odour	265.27	203mm ø BOREHOLE	1SS	☒	9
	Little to some silt, dark brown to black, wet, no odour			2SS	☒	2
5.0	Trace product, strong coal tar odour, sheen, black	262.98	BENTONITE GROUT	3SS	☒	8
	SP(SAND), trace gravel, fine grained, poorly graded, very loose, black, wet, strong coal tar odour product	261.45		4SS	☒	9
7.5	Trace to little gravel, shell fragments, brown to black, medium dense, wet, coal tar odour	260.08		5SS	☒	2
	SW-GW(SAND/GRAVEL), some sand, some gravel medium to coarse grained, well graded, dense brown, wet, no odour			6SS	☒	18
10.0	Very dense			7SS	☒	35
12.5	Auger refusal			8SS	☒	>50
	END OF HOLE @ 8.08 m BGS.					
	NOTES: 1.Contamination approximately 4.57 to 6.4m BGS.					
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(...-02)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 3318
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH19-90
DATE COMPLETED: FEBRUARY 7, 1990
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND ELEVATION	268.17				
2.5	SM(SAND)FILL, some sand, some silt, little gravel, trace clay, fine grained, poorly graded, loose, brown, very moist	265.28	CONCRETE SURFACE SEAL	1SS		6
	SP(SAND), little silt, trace clay, fine grained, medium dense, brown, wet, no odour or product	265.27	203mmø BOREHOLE	2SS		15
5.0	Dense		BENTONITE GROUT	3SS		38
	Medium grained	262.53		4SS		28
7.5	SM(SAND), little silt, fine grained, poorly graded, medium dense, brown, wet, no odour	261.31		5SS		53
	Thin clay seam at 6.55m BGS, no odour	260.55		6SS		21
10.0	SW-GW(SAND/GRAVEL), some sand, some gravel, medium coarse grained, well graded, medium dense, brown, wet, no odour			7SS		>50
	Very dense					
12.5	END OF HOLE @ 7.62 m BGS.					
	NOTES: 1. Auger refusal at 7.62m BGS.					
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 3318
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH20-90
DATE COMPLETED: FEBRUARY 8, 1990
DRILLING METHOD: 108mm O.D. HSA
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND ELEVATION	268.28				
	Asphalt	268.13	CONCRETE SURFACE SEAL			
	SW(SAND)FILL, some sand, little gravel, fine to medium grained, well graded, cobbles, medium dense, brown, moist, no odour			1SS		14
2.5				2SS		21
	SP(SAND), some sand, trace silt, fine grained, poorly graded, loose, brown, moist, no odour	265.23	203mmø BOREHOLE	3SS		9
				4SS		20
5.0	Product (2.54cm) at 5.79m BGS., sheen, strong coal tar odour		BENTONITE GROUT	5SS		>30
	Sheen, strong coal tar odour	261.88		6SS		>50
	SM(SAND), some sand, some silt, fine grained, poorly graded, brown, dense, wet, slight coal tar odour	261.42		7SS		>50
7.5		260.66		8SS		17
	SW-GW(SAND/GRAVEL), some sand, some gravel, medium to coarse grained, well graded, medium dense, brown, wet, no odour					
10.0	END OF HOLE @ 7.62 m BGS.					
	NOTES: 1. Auger refusal at 7.62m BGS.					
12.5						
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-04)

PROJECT NAME: FORMER GALT GAS CO. SITE
PROJECT NO.: 3318
CLIENT: MILLRACE ON THE GRAND INC.
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH21-90
DATE COMPLETED: FEBRUARY 7, 1990
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: K. VANDERMEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND ELEVATION	268.16				
	Asphalt	268.07	CONCRETE SURFACE SEAL			
2.5	SW(SAND)FILL, some sand, little gravel, trace to little silt, fine to medium grained, cobbles, construction material, well graded, very dense, brown, moist, no odour		203mmø BOREHOLE			
		264.50		1SS	☒	11
		264.35	BENTONITE GROUT			
5.0	SW(SAND), some sand, littel gravel, fine to coorse grained, well graded, medium dense, brown, wet			2SS	☒	28
		261.76		3SS	☒	>50
7.5	ML(SILT), trace sand, trace clay, fine grained, dilatent, very dense, brown, wet	260.84				
	SW-GW(SAND/GRAVEL), some sand, some gravel, fine coorse grained, well graded, rock, brown, wet, no odour or product			4SS	☒	69
		259.17		5SS	☒	>50
10.0	No odour or product Auger refusol					
	END OF HOLE @ 8.99 m BGS.					
12.5						
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

LOG OF BOREHOLE No. 1

JOB NAME NEWLANDS TEXTILES INC. PROPERTY — JOB No. 84-F-103

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO — BORING DATE 1984.10.04 — ENGINEER P.M.B

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS — TECHNICIAN P.M.B

DEPTH ft.	DESCRIPTION	GROUND ELEVATION 880.4	GRAPHIC LOG	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/6 INCHES VARIES	SHEAR STRENGTH C_u ▲ / DYNAMIC CONE PENETRATION ▲ STANDARD PENETRATION TEST ▲ BLOWS/FOOT 70 40 40 80	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w w_P w w_L WATER CONTENT 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
0	ASPHALTIC CONCRETE									
	FILL: Medium sand, some gravel to ¼ in. diameter damp				1	SS	9			
5				875	2	SS	6			
8.0	becoming black silty sand, some to a trace of gravel some slag fill moist				3	SS	16			
10				870	4	SS	6			
12.0	SAND: Compact brown medium sand, wet				5	SS	26			
15				865	6	SS	14			
19.0	encountering grey brown clayey silt layers to 1 in. thick, wet			860	7	SS	21			
22.3	GRAVEL: Very dense brown gravel and coarse sand, trace of silt, wet			855	8	SS	79			Upon completion of drilling, no free water, cave at 13.3 ft.
27.3	Borehole terminated at 27.3 ft. Auger refusal at possible boulder or bedrock									
30										
35										
40										
45										
50										
55										
60										

NOTES

CHECKED BY A.A.O

LOG OF BOREHOLE No. 2

JOB NAME NEWLANDS TEXTILES INC. PROPERTY — JOB No. 84 E 103

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO — BORING DATE 1984 10 05 — ENGINEER B K B

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS — TECHNICIAN B K B

DEPTH ft.	DESCRIPTION	SYMBOL	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT (STANDARD PENETRATION VALUES) N	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT 20 40 60 80	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 878.9								
	FILL: Dark brown and brown silty sand, and gravel to 1 in. diameter, damp, occassional concrete and slag pieces		875	1	SS	18			
5				2	SS	85			
			870	3	SS	59			
10									
11.0				4	SS	2			
	ORGANIC SILT: Very loose black organic silt, wet		865	5	SS	2			9.0 ft
15				6	SS	9			8.4 ft
17.0									
	SAND: Loose dark grey and black medium-fine sand, some organic shells, wet		860	7	SS	7			
20	encountering brown peat			8	SS	29			
21.6	GRAVEL: Dense to very dense brown gravel to 1¼ in. diameter some coarse sand, wet		855						
25				9	SS	35			
			850						
30				10	SS	50/2 in.			After sample 10 free water at 11.0 ft. inside augers.
			845						
35									
			840						
40									
42.5	Borehole terminated at 42.5 ft.		835						Upon completion of drilling, no free water, cave at [illegible] ft
45									
50									
55									
60									

NOTES Power augered to 42.5 ft., no samples taken below 30.2 ft., soil description based on auger cuttings and observations during drilling.

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LOG OF BOREHOLE No. 3

JOB NAME NEWLANDS TEXTILES INC. PROPERTY — JOB No. 84-F-123

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO — BORING DATE 1984.10.05 — ENGINEER P.K.B.

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS — TECHNICIAN P.K.B.

DEPTH ft.	DESCRIPTION (GROUND ELEVATION 876.5)	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FOOT VALUES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT	WATER CONTENT	GROUNDWATER OBSERVATIONS AND REMARKS
2.6	FILL: Brown silty sand and gravel fill encountering black cinder fill	875	1	SS	3			
		870	2	SS	3			50.0*
	encountering black cinder fill and black coarse sand and gravel to 1 in. diameter some brick rubble, wet		3	SS	6			
12.0		865	4	SS	24			
14.0	ORGANIC SILT: Loose black organic silt, wet		5	SS	7			
15	SAND: Loose grey medium-fine sand some organic shells	860	6	SS	9			After sample 6 free water at 11 ft. inside auger
17.6	GRAVEL: Very dense grey gravel and coarse sand, wet		7	SS	75/11 in.			
20		855	8	SS	80			After sample 8 free water at 12 ft. inside auger
25		850	9	SS	43			
28.2	Borehole terminated at 28.2 ft. Auger refusal on possible boulder or bedrock							Upon completion of drilling, no free water, cave at 6.5 ft.
30								
35								
40								
45								
50								
55								
60								

NOTES

CHECKED BY CKB

LOG OF BOREHOLE No. 6

JOB NAME NEWLANDS TEXTILES INC. PROPERTY
LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO BORING DATE 1984.10.05
BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS

DEPTH ft.	DESCRIPTION	GROUND ELEVATION 879.1	GRAPHIC LOG	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	RECOVERY % / RQD %	SHEAR STRENGTH C_u ● DYNAMIC CONE PENETRATION ○ STANDARD PENETRATION TEST × BLOWS/FOOT 20 40 60 80	LIQUID LIMIT ⊢ PLASTIC LIMIT ⊢ WATER CONTENT ● WATER CONTENT % 10 20 30	PIEZOMETER AND STANDPIPE INSTALLATIONS AND BACKFILL
2.5	FILL: Brown silty sand and gravel, moist				1	SS	6			
	becoming red brown medium sand, moist			875	2	SS	5			
8.5	becoming black sand and			870	3	SS	13			
15.0	ORGANIC SILT: Very loose black organic silt, moist			865	4	SS	3			
					5	SS	5			
20.5	SAND: Loose dark grey medium sand, wet			860	6	SS	8			
	PEAT AND SAND: Loose brown peat with medium sand layers wet				7	SS	15			
23.0	GRAVEL: Very dense brown gravel, wet			855						
				850						
				845						
40.0				840						
	SAND: Very dense brown sand, wet			835						
				830						
				825						
60.0				820						
	Borehole terminated at 60.0 ft.									

Upon completion of drilling, free water at 12.0 ft cave at 21.0 ft.

4 hours after drilling, free water at 11.9 ft cave at 17.0 ft.

NOTES Power augered to 60.0 ft., no samples taken below 21.5 ft., soil description based on auger cuttings and observations during drilling.

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LOG OF BOREHOLE No 5

JOB NAME NEWLANDS TEXTILES INC PROPERTY JOB No 84-5

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO BORING DATE 1984 10 05 ENGINEER P.W.B.

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS TECHNICIAN P.W.B.

DEPTH ft.	DESCRIPTION	GROUND ELEVATION 878.3	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT 'N' VALUES	SHEAR STRENGTH C_u • DYNAMIC CONE PENETRATION ▲ STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: Brown silty sand and gravel to 1½ in. diameter, some bricks, moist			875	1	SS	8			
5					2	SS	2			
8.5				870	3	SS	4			
10.0	ORGANIC SILT: V. loose dk grey organic silt, moist				4	SS	32			
12.3	GRAVEL: Dense grey black gravel to 1½ in. diameter trace limestone, some silty sand becoming wet			865	5	SS	19			
15					6	SS	18			
16.4	SILTY CLAY: Very soft brown silty clay, W.T.P.L.			860	7	SS	18			
18.3	SILT: Compact light brown silt, some fine sand, wet				8	SS	7			
20	SAND: Compact brown medium to fine sand, wet									
21.4	SILT: Compact brown with rust staining silt, moist			855						
24.0	SAND: Compact brown fine sand, wet, some limestone gravel				9	SS	10			
25										
28.0	GRAVEL: Very dense brown gravel, wet			850						
30										
32.0	SAND: Very dense brown gravel, wet			845						
35										
				840						
40										
42.5	Borehole terminated at 42.5 ft.			835						
45										
50										
55										
60										

Upon completi of drilling, water at 12.5 cave at 13.5

24 hours afte drilling free water at 13.3 cave at 13.5

NOTES

* Suspect low "N" values caused by excessive differential hydraulic gradient.

Power augered to 42.5 ft., no samples taken after 27.3 ft., soil description based on auger cuttings and observations during drilling.

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PWL/1504

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LOG OF BOREHOLE No. 6

JOB NAME NEWLANDS TEXTILES INC. PROPERTY — JOB No 84-F-122

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO — BORING DATE 1984 10 09 — ENGINEER P.K.B

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS — TECHNICIAN P.K.B

DEPTH ft.	DESCRIPTION (GROUND ELEVATION 880.?)	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/6 INCHES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT (20, 40, 60, 80)	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT — WATER CONTENT % (10, 20, 30)	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: Black and dark brown silty sand topsoil			1	SS	6			
1.0									
	SAND: Compact light brown silty sand, some rust staining, trace of organics, moist		875	2	SS	14			
7.0	becoming dense light brown medium sand, some gravel to .5 in. diameter, damp			3	SS	40			
			870	4	SS	48			
15.0	becoming very dense grey medium to coarse sand, moist		865	5	SS	51			
20.0	SANDY SILT: Compact brown sandy silt, wet		860	6	SS	29			After sample 6 free water at 18.8 ft. inside augers.
22.0	GRAVEL: Very dense brown gravel, wet			7	SS	50/6 in.			
			855						
			850						
34.0	SAND: Very dense brown sand, wet		845						
			840						
42.5	Borehole terminated at 42.5 ft.								Upon completion of drilling, no free water, cave at 14.0 ft.

NOTES: Power augered to 42.5 ft., no samples taken below 25.5 ft., soil description based on auger cuttings and observations during drilling.

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PML/184

LOG OF BOREHOLE No

JOB NAME NEWLANDS TEXTILES INC. PROPERTY — JOB No 84-F-323

LOCATION 160 WATER STREET NORTH, CAMBRIDGE, ONTARIO — BORING DATE 1984.10.09 — ENGINEER B.A.B.

BORING METHOD CONTINUOUS FLIGHT HOLLOW STEM AUGERS — TECH. A.T.B.

DEPTH ft.	DESCRIPTION GROUND ELEVATION 881.9	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT 'N' VALUES	SHEAR STRENGTH C_u ● DYNAMIC CONE PENETRATION ○ STANDARD PENETRATION TEST ○ BLOWS/FOOT 20 40 60 80	LIQUID LIMIT ⊢ PLASTIC LIMIT ⊢ WATER CONTENT ● WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: Black and brown silty sand, trace black organics, moist			1	SS	6			
			880	2	SS	7			
5 — 6.0	SAND: Loose red brown medium to fine sand, damp-moist								
9.0			875	3	SS	8			
10	encountering some gravel			4	SS	5			
13.0			870	5	SS	34			
15	GRAVEL: Very dense brown gravel and coarse sand, damp			6	SS	85			
17.0	becoming wet		865	7	SS	39			
20 — 21.0				8	SS	51			After sample 8 free water at 17.0 ft. inside augers.
	SAND: Very dense red brown coarse sand, some gravel to 1 in. diameter, wet		860						
25									
26.5			855						
30 — 31.0	GRAVEL: Very dense brown gravel, wet								Upon completion of drilling, no free water, cave at 16.5 ft.
	Borehole terminated at 31.0 ft. Auger refusal on possible boulder or bedrock		850						
35									
40									
45									
50									
55									
60									

NOTES Power augered to 31.0 ft., no samples taken below 21.5 ft., soil description based on auger cuttings and observations during drilling.

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LOG OF BOREHOLE No. 101

JOB NAME: PROPOSED MILL RACE CONDOMINIUMS — JOB No.: 86-F-132

LOCATION: Water Street North, Cambridge, Ontario — BORING DATE: 1986.04.18 — ENGINEER: G. Marcone

BORING METHOD: Continuous Flight Hollow Stem Augers — TECHNICIAN: D. Kelly

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/FOOT 'N' VALUES	SHEAR STRENGTH C_u • DYNAMIC CONE PENETRATION ○ STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	LIQUID LIMIT ——● PLASTIC LIMIT ——► WATER CONTENT ——○ WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 878.1							
	FILL: Asphaltic concrete pavement over reddish brown, dark brown, and black mixture of silt and sand with some gravel, trace of brick and organics, moist to saturated	875	1	SS	21			
			2	SS	51			
		870	3	SS	28			
			4	SS	51			
	SAND AND GRAVEL: Dense to very dense fine to coarse sand and gravel, saturated	865	5	SS	40			Borehole becoming wet after sample 5.
			6	SS	38			
		860						
20.0	becoming coarse sand and gravel		7	SS	67			
		855						
			8	SS	100/4"			Blowback inside augers at 25.0 ft.; began washboring.
		850						
31.0			9	SS	83			
	Borehole terminated at 31.0 ft.							Upon completion of drilling, borehole caved and water level at 11.0 ft.

NOTES

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LOG OF BOREHOLE No 102

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — JOB No 86 F 32

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.04.18 — ENGINEER G. Mitche

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN A. McC

DEPTH	DESCRIPTION	LEGEND	ELEVATIONS	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/6INCH VALUES	SHEAR STRENGTH C_u psf — DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST (BLOWS/FOOT)	LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT — WATER CONTENT	PIEZOMETER OR STANDPIPE OBSERVATIONS AND REMARKS
	GROUND ELEVATION 879.0								
0	FILL: Asphaltic concrete pavement over brown and dark brown mixture of silt and sand with some gravel, trace of organics, moist		875	1	SS	13			
				2	SS	6			
10			870	3	SS	6			
				4	SS	19			
12.0	SAND: Very dense brown fine to coarse sand with little gravel, saturated		865						
15				5	SS	74			
19.0	becoming medium to coarse sand with little gravel, saturated		860						
20				6	SS	81			
25			855	7	SS	100/9"			
			850						
30				8	SS	60			
31.5	Borehole terminated at 31.5 ft.								Upon completion of drilling, borehole caved and water level at 11.9 ft.
40									
45									
50									
55									
60									

NOTES

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LOG OF BOREHOLE No 103

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — Pg. 1 of 1

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.04.22 — ENGINEER G. Mitchell

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN S. [illegible]

DEPTH	SOIL PROFILE: DESCRIPTION	ELEVATION	NUMBER	TYPE	SAMPLES: BLOWS/6 INCHES VALUES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST: BLOWS/FOOT (20 40 60 80)	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT: WATER CONTENT % (10 20 30)	BOREHOLE OBSERVATIONS AND REMARKS
	GROUND ELEVATION 879.9							
	FILL: Brown, light brown, and red mixture of silt and sand with some gravel, occasional cobbles and brick pieces, moist	875	1	SS	14			
			2	SS	11			
7.5	becoming brown and dark brown silty sand, some gravel, very moist	870	3	SS	5			
			4	SS	13			
12.5	coal inclusions below 12.5 ft. with strong oil smell, saturated	865	5	SS	6			Borehole becoming wet after sample 5.
			6	SS	11			42%
17.0	SAND: compact black silty sand, trace of shells and organics, strong oil smell, saturated (possible fill)	860	7	SS	23			
23.0	SAND AND GRAVEL: Compact to dense grey fine to coarse sand and gravel, saturated	855	8	SS	21			Blowback inside augers at 25 ft.; began washboring.
		850	9	SS	119			
36.0	Borehole terminated at 36.0 ft.	845	10	SS	105			Upon completion of drilling borehole caved to 19.5 ft. and water level at 10.5 ft.

NOTES

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PMC/SBA

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

LOG OF BOREHOLE No 104

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — JOB No 86-F-132

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.04.22 — ENGINEER G. Mitterer

BORING METHOD Continuous Flight Solid Stem Augers — TECHNICIAN D. Kelly

DEPTH	DESCRIPTION GROUND ELEVATION 876.±	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m (12")	SHEAR STRENGTH C_u • DYNAMIC CONE PENETRATION + STANDARD PENETRATION TEST × BLOWS/FOOT 20 40 60 80	LIQUID LIMIT ⊢ PLASTIC LIMIT ⊢ WATER CONTENT ○ WATER CONTENT % 10	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: 3.0 in. concrete slab over fine to medium sand, some gravel, trace silt, moist to saturated		875	1	SS	6			
			870	2	SS	13	Proposed sewer invert level		
9.0				3	SS	4			
	SAND: Compact grey coarse sand with little gravel, strong smell of oil, saturated		865	4	SS	12			Borehole becom wet after samp 4.
14.0									
16.5	SILT: Dense brown sandy silt, trace gravel, saturated		860	5	SS	49			
	Borehole terminated at 16.5 ft.								Upon completio of drilling, borehole caved at 8.0 ft. wit no free water.

NOTES

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LOG OF BOREHOLE No. 105

JOB NAME: PROPOSED MILL RACE CONDOMINIUMS
LOCATION: Water Street North, Cambridge, Ontario
BORING DATE: 1986.04.22
BORING METHOD: Continuous Flight Solid & Hollow Stem Augers
JOB #: 86 F 32
ENGINEER: D. Mitche...
TECHNICIAN: D. Wells

DEPTH	DESCRIPTION	ELEVATION	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/FOOT OR RECOVERY	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT (20, 40, 60, 80)	LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT w_p — WATER CONTENT	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 877.9							
	FILL: Brown mixture of fine to coarse sand with gravel, moist	875	1	SS	16			
5			2	SS	35			
6.5								
	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, damp	870	3	SS	63	Proposed sewer invert level		
10.0	becoming medium to coarse sand and gravel, saturated		4	SS	50			
14.0		865						
15	SAND: Dense brown silty sand, occasional clayey silt seams, saturated		5	SS	31			
	Borehole terminated at 17.0 ft.							

Upon completion of drilling, water level at 13.5 ft. inside augers.

After removing augers, borehole caved to 3.0 ft. with no free water.

NOTES

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PML/150

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

LOG OF BOREHOLE No. 106

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — JOB # 86-E-122

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.04.22 — ENGINEER D. Metcha...

BORING METHOD Continuous Flight Solid Stem Augers — TECHNICIAN D. Re...

DEPTH	DESCRIPTION	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FOOT (STD. PEN. TEST)	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT (20 40 60 80)	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT — w_P w w_L — WATER CONTENT (10 20)	REMARKS AND OBSERVATIONS
	GROUND ELEVATION 878.2							
	FILL: 2.5 in. concrete slab over brown clayey silt, with some sand and gravel, very moist	875	1	SS	10	•	○	
5.0	SAND: Compact brown and light brown silty sand, occasional silt seams, very moist to saturated		2	SS	14	• Proposed sewer invert level	□	
		870	3	SS	30	•	◇	
10			4	SS	19	•	○	Borehole becom... wet after sampl... 4.
		865						
15			5	SS	15	•	○	
17.0	Borehole terminated at 17.0 ft.							Upon completion of drilling, borenole caved at 12.0 ft. wit... water level at 11.0 ft.
20								
25								
30								
35								
40								
45								
50								
55								
60								

NOTES

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PML-1184

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LOG OF BOREHOLE No. 107

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — JOB No. 86 F 22

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.04.23 — ENGINEER G. Mierzwa

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN D. Kelly

DEPTH	DESCRIPTION (GROUND ELEVATION 895.6)	GRAPHIC LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FOOT OR WATER CONTENT %	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT (20, 40, 60, 80)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT % — WATER CONTENT % (10, 20, 30)	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: Dark brown and brown mixture of silt and sand with little gravel, occasional pieces of asphalt, concrete, brick and coal, moist to very moist			1	SS	30			
			890	2	SS	6			
				3	SS	6			
10			885	4	SS	19			
15			880	5	SS	16			
18.0	SILT: Compact reddish brown sandy silt, moist to wet								
20			875	6	SS	11	Proposed sewer invert level		
25			870	7	SS	14/6 in. bouncing			
27.0	Borehole terminated at 27.0 ft. upon meeting refusal to auger on possible bedrock								Upon completion of drilling, borehole caved to 24.0 ft. with no free water.
30									
35									
40									
45									
50									
55									
60									

NOTES

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PML/SB4

LOG OF BOREHOLE No. 108

JOB NAME PROPOSED MILL RACE CONDOMINIUMS JOB No. 86-F-13

LOCATION Water Street North, Cambridge, Ontario BORING DATE 1986.04.23 ENGINEER G. Mitche..

BORING METHOD Continuous Flight Solid & Hollow Stem Augers DATUM G. No.

DEPTH	DESCRIPTION GROUND ELEVATION 877.9	ELEVATION	NUMBER	TYPE	BLOWS/6 INCHES VALUES	SHEAR STRENGTH C_u ▲ DYNAMIC CONE PENETRATION • STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	LIQUID LIMIT ⊢ PLASTIC LIMIT ⊢ WATER CONTENT ○ WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
	FILL: 16.0 in. concrete slab over brown mixture of fine to coarse sand and gravel, little silt, moist	875	1	SS	25	Proposed sewer invert level		
5			2	SS	21			
		870	3	SS	18			
10	10.0 ORGANIC SILT: Stiff dark grey organic silt with sand seams, wet		4	SS	11			Borehole becoming wet after sample 4
	13.0 SAND: Compact dark grey fine to medium sand, trace of organics, strong smell of oil, saturated (possible fill)	865	5	SS	11			
15	16.5 Borehole terminated at 16.5 ft.		6	SS	13			Upon completion of drilling, water level at 8.0 ft. inside hollow stem augers After removing augers borehole caved to 2.0 ft. with no free water.
20								
25								
30								
35								
40								
45								
50								
55								
60								

NOTES

CHECKED BY gk

PWL-104

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

LOG OF BOREHOLE No. 201

JOB NAME PROPOSED MILL RACE CONDOMINIUMS JOB No. 86-F-32A

LOCATION Water Street North, Cambridge, Ontario BORING DATE 1986.06.02 ENGINEER D. Marsh

BORING METHOD Continuous Flight Hollow Stem Augers TECHNICIAN D. Neely

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N VALUES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST (BLOWS/FOOT)	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT (WATER CONTENT %)	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 878.2							
	FILL: 1.5 in. of asphaltic concrete over brown fine to coarse sand and gravel, occasional cobble, damp	875	1	SS	45			
5			2	SS	56			
7.0		870	3	SS	62			
10	SAND: Compact to dense brown fine to medium sand, trace silt, occasional seams of sand and gravel, damp to saturated		4	SS	23			
		865						
15			5	SS	20			After sample 5, water level at 13.5 ft. with 1.0 ft. of blowback inside augers
		860						
20			6	SS	22			
		855						
25.0	SAND AND GRAVEL: Very dense brown fine to medium sand and gravel, numerous silt seams, occasional cobbles, saturated		7	SS	55			
30		850						
			8	SS	119/8 in.			
		845						
35			9	SS	77			
		840						
40			10	SS	87			
41.5	Borehole terminated at 41.5 ft.							Upon completion of drilling, borehole caved to 8.0 ft. with no free water
45								
50								
55								
60								

NOTES

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PML/104

LOG OF BOREHOLE No. 202

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — JOB No. 86-F-120

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.06.02 — DRILLED BY Maheux

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN [illegible]

DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: GRAPHIC LEGEND	SOIL PROFILE: ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m (1 FT.)	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT	WATER CONTENT (%)	OBSERVATIONS AND REMARKS
	GROUND ELEVATION 880.1						20 40 60 80	10 20	
0	FILL: 2.0 in. of asphaltic concrete over dark brown fine to medium sand and gravel, damp			1	SS	12			
			875	2	SS	4			
5									
9.0				3	SS	8			
10	becoming wet with inclusions of coal and brick, strong smell of oil		870	4	SS	9			
12.0									
	ORGANIC SILT: Black organic silt, sand seams, saturated			5	SS	23			
14.0			865						
15	SAND: Compact to very dense brown fine to medium sand, occasional silt seams, saturated			6	SS	17			After sample 6, water level at 14.0 ft.
20			860	7	SS	80			
25			855						
26.0				8	SS	34			
	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated								
29.0									
30	Borehole terminated at 29.0 ft. upon meeting refusal to auger		850						Upon completion of drilling, borehole caved to 13.3 ft. with no free water
35									
40									
45									
50									
55									
60									

NOTES

CHECKED BY gk

LOG OF BOREHOLE No 203

JOB NAME PROPOSED MILL RACE CONDOMINIUMS

LOCATION Water Street North, Cambridge, Ontario BORING DATE 1986.06.03

BORING METHOD Continuous Flight Hollow Stem Augers

DEPTH	DESCRIPTION GROUND ELEVATION 880.2	GRAPHIC	ELEVATION	NUMBER	TYPE	BLOWS/6 INCHES OR N VALUES	SHEAR STRENGTH C_u ▲ DYNAMIC CONE PENETRATION + STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 10 20 30	GROUNDWATER OBSERVATIONS AND REMARKS
0	FILL: Brown fine to medium sand, little gravel, damp			1	SS	5			
			875	2	SS	7			
5	becoming dark brown and black fine to coarse sand and gravel with pieces of coal and asphaltic concrete			3	SS	3			
			870	4	SS	17			
10				5	SS	4			After sample 5, water level at 12.0 ft.
13.5	ORGANIC SILT: Loose dark grey organic silt, numerous sand seams, saturated		865	6	SS	4		43%	
				7	SS	3		55%	Water sample taken following sample 6
20	becoming organic sand with shells		860	8	SS	8			
21.0	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated		855	9	SS	120/9 in.			
			850	10	SS	50			
35.0	Borehole terminated at 35.0 ft. upon meeting refusal to auger		845						Upon completion of drilling, borehole caved to 12.0 ft. with water level at 7.3 ft.
40									
45									
50									
55									
60									

NOTES

CHECKED BY

PML 304

LOG OF BOREHOLE No 2

JOB NAME PROPOSED MILL FACE CONDOMINIUMS — HN 86-F-1324

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1986.06.03 — ENGINEER D. Murphy

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN D. Kelly

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/6 INCH INTERVAL	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT (20, 40, 60, 80)	LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT — WATER CONTENT %	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 879.4								
0	FILL: Dark brown fine to medium sand and gravel, occasional organic inclusions, damp to wet		875	1	SS	3			
5				2	SS	1/18 in.			
10			870	3	SS	4			
12.5				4	SS	2			
15	ORGANIC SILT: Loose dark grey organic silt with occasional sand seams, saturated		865	5	SS	2			After sample 5 water level at 11.5 ft.
18.0	becoming organic sand with shells		860	6	SS	3		47%	
20				7	SS	6			
22.0	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated		855	8	SS	88/8 in.			
25			850						
30				9	SS	102			
31.5	Borehole terminated at 31.5 ft. upon meeting refusal to auger								Upon completion of drilling, borehole caved to 5.0 ft. with no free water
35									
40									
45									
50									
55									
60									

NOTES

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LOG OF BOREHOLE No 205

JOB NAME PROPOSED MILL RACE CONDOMINIUMS — [illegible] 96 F 1122

LOCATION Water Street North, Cambridge, Ontario — BORING DATE 1996.06.24 — ENGINEER C. Mitchell

BORING METHOD Continuous Flight Hollow Stem Augers — [illegible] Wells

DEPTH	SOIL PROFILE: DESCRIPTION (GROUND ELEVATION 879.4)	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	N VALUE OR RQD	SHEAR STRENGTH C_u • / DYNAMIC CONE PENETRATION + / STANDARD PENETRATION TEST • — BLOWS/FOOT (20, 40, 60, 80)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT	GROUNDWATER OBSERVATIONS AND REMARKS
0	FILL: Dark grey and black fine to medium sand, little gravel, coal, brick pieces and cinders, moist to wet		875	1	SS	14			
				2	SS	8			
10			870	3	SS	7			
				4	SS	2			
12.0									
	ORGANIC SILT: Loose dark grey organic silt, saturated		865	5	SS	3		44%	
15				6	SS	5			
17.5	becoming organic sand with shells		860						
20				7	SS	3			After sample 7, water level at 17.5 ft.
22.5	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated		855						
25				8	SS	100/3 in.			
27.5	Borehole terminated at 27.5 ft. upon meeting refusal to auger		850						Upon completion of drilling, borehole open to 20.0 ft. with water level at 13.5 ft.
30									
35									
40									
45									
50									
55									
60									

NOTES

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PML/104

LOG OF BOREHOLE No 3

JOB NAME PROPOSED MIXED RACE CONDOMINIUMS

LOCATION Water Street North, Cambridge, Ontario BORING DATE 1986.06.04

BORING METHOD Continuous Flight Hollow Stem Augers

DEPTH	SOIL PROFILE: DESCRIPTION	GROUND ELEVATION 880.0	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	BLOWS/SIX INCHES N VALUES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/FOOT	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT — WATER CONTENT %	PIEZOMETER OR STANDPIPE INSTALLATIONS AND REMARKS
	FILL: Black mixture of sand, cinders, and coal, moist to saturated				1	SS	24			
5				875	2	SS	10			
					3	SS	14			
10				870	4	SS	4		47%	
12.0	ORGANIC SILT: Loose dark grey organic silt, some sand seams, saturated				5	SS	3		54%	
15				865	6	SS	3			
19.0	becoming organic sand with shells			860	7	SS	8		66%	After sample 7, water level at 17.5 ft.
20	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated			855	8	SS	101			
25										
29.5	Borehole terminated at 29.5 ft. upon meeting refusal to auger			850						Upon completion of drilling, borehole caved to 17.5 ft. with water level at 10.2 ft.
30										
35										
40										
45										
50										
55										
60										

NOTES

CHECKED BY

LOG OF BOREHOLE No 207

JOB NAME: PROPOSED MILL RACE CONDOMINIUMS — 86 F 1328

LOCATION: Water Street North, Cambridge, Ontario — BORING DATE: 1986 ... 04 ... 25 — ... Mitchell

BORING METHOD: Continuous Flight Hollow Stem Augers — ... Geo...

DEPTH	DESCRIPTION (GROUND ELEVATION 878.2)	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/6 INCHES	SHEAR STRENGTH C_u ● / DYNAMIC CONE PENETRATION ○ / STANDARD PENETRATION TEST ● — BLOWS/FOOT (20, 40, 60)	LIQUID LIMIT ⊢ / PLASTIC LIMIT ⊢ / WATER CONTENT ○ — WATER CONTENT (%)	REMARKS AND OBSERVATIONS
0	FILL: Dark grey and black fine to coarse sand with coal and brick, moist to saturated		875	1	SS	37			
2.5				2	SS	6			
	ORGANIC SILT: Loose dark grey organic silt, occasional sand seams, saturated		870	3	SS	3		46%	
10				4	SS	3		56%	
15			865	5	SS	6		47%	
17.0	becoming organic sand with shells		860						
20				6	SS	7		53%	⊕After sample 6, water level at 18.5 ft.
22.0	SAND AND GRAVEL: Very dense brown fine to coarse sand and gravel, saturated		855						
25				7	SS	83			
30			850						
				8	SS	147			
35			845						
35.0	Borehole terminated at 35.0 ft								Upon completion of drilling, borehole caved to 20.0 ft. with water level at 10.5 ft.
40									
45									
50									
55									
60									

NOTES

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PMEL-104

APPENDIX D

MISCELLANEOUS FIELD DATA

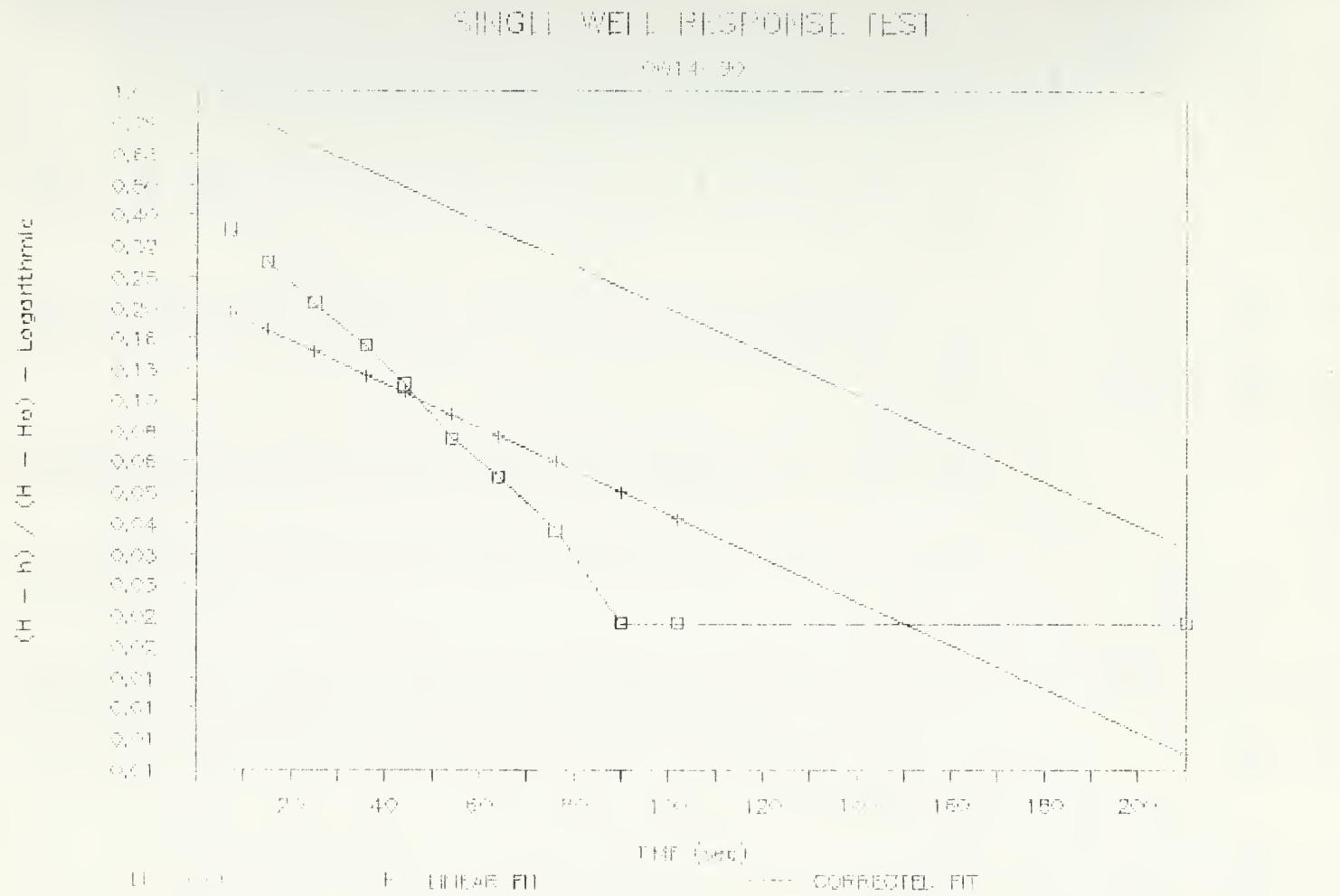
SINGLE WELL RESPONSE TEST - DATA AND CALCULATIONS
HVORSLEV METHOD (1951)

JECT NAME:	MILL RACE ON THE GRAND	HOLE DESIGNATION:	OW14-90
JECT NUMBER:	2087	DATE TESTED:	FEB. 27/90
ENT:	C.N.A. Holdings Inc.	TEST TYPE:	Falling
ERVISOR:	Ken VanderMeulen		

. ELEVATION:	268.41 m AMSL	WELL RADIUS (r):	0.025 m
TIC DEPTH (H):	4.440 m	BOREHOLE RADIUS (R):	0.102 m
G VOLUME:	1.046 L	SCREEN LENGTH (L):	1.220 m
PL. (H-Ho):	0.533 m	TIME LAG (To):	61 sec

RAULIC CONDUCTIVITY K= (r*r*ln(L/R))/(2*L*To): 1.0E-03 cm/sec

TIME (actual time)			WATER	DISPL.	%DISPL.
days	(HH:MM:SS)	TOTAL	DEPTH	H - h	(H-h)/
START TIME:	00:00:00	(sec.)	(h)		(H-Ho)
	00:00:07	7	4.250	0.190	0.357
	00:00:15	15	4.290	0.150	0.282
	00:00:25	25	4.330	0.110	0.206
	00:00:36	36	4.360	0.080	0.150
	00:00:44	44	4.380	0.060	0.113
	00:00:54	54	4.400	0.040	0.075
	00:01:04	64	4.410	0.030	0.056
	00:01:16	76	4.420	0.020	0.038
	00:01:30	90	4.430	0.010	0.019
	00:01:42	102	4.430	0.010	0.019
	00:03:30	210	4.430	0.010	0.019


SINGLE WELL RESPONSE TEST
(H - h) / (H - Ho) - Logarithmic
TIME (sec)
LINEAR FIT
CORRECTED FIT

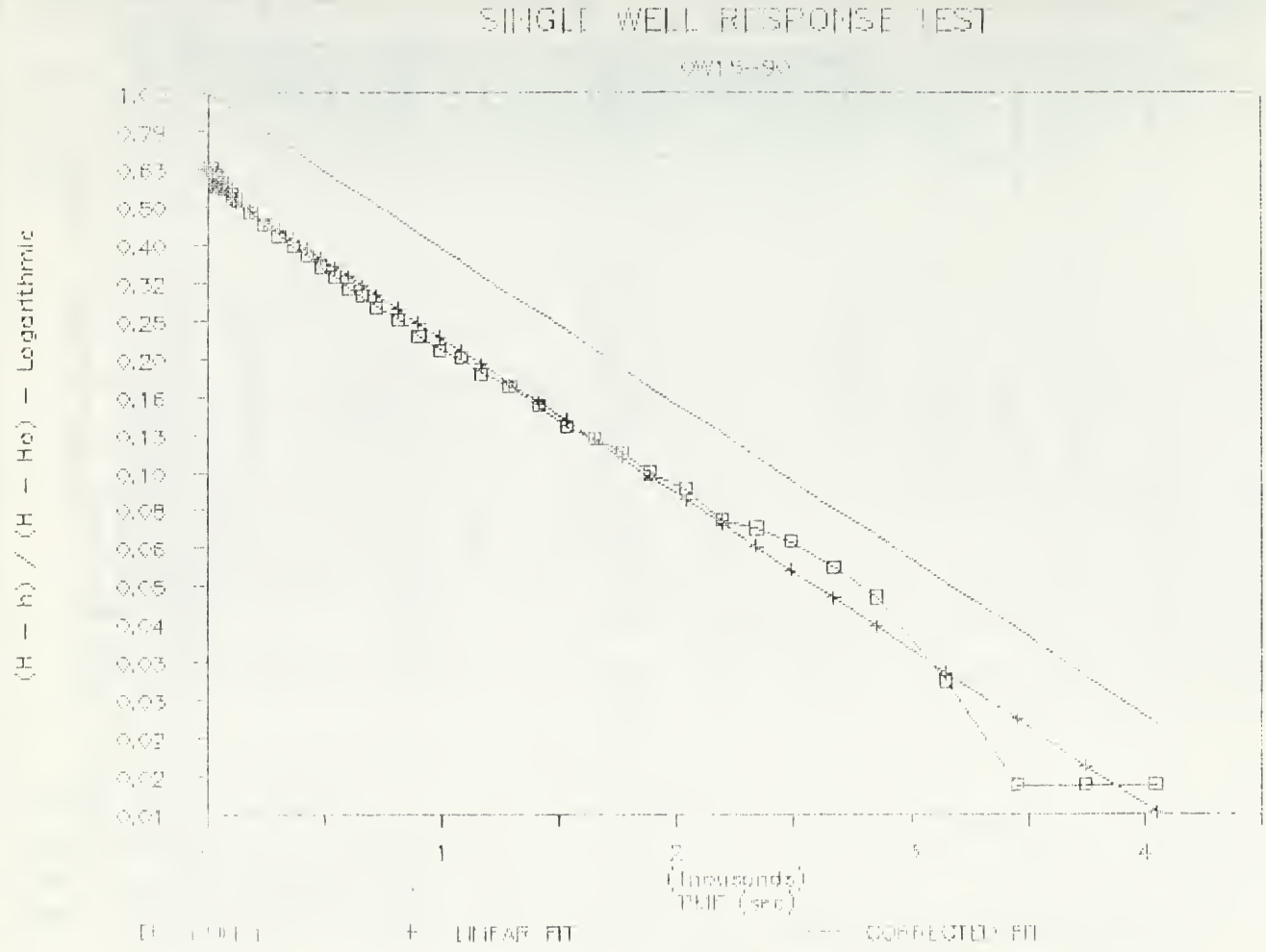
SINGLE WELL RESPONSE TEST - DATA AND CALCULATIONS
HVORSLEV METHOD (1951)

JECT NAME:	MILL RACE ON THE GRAND	HOLE DESIGNATION:	OW15-90
JECT NUMBER:	2087	DATE TESTED:	Feb. 27/90
ENT:	C.N.A. Holdings Inc.	TEST TYPE:	Falling
ERVISOR:	Lisa Lavallee		

ELEVATION:	268.54 m AMSL	WELL RADIUS (r):	0.025 m
TIC DEPTH (H):	4.490 m	BOREHOLE RADIUS (R):	0.102 m
G VOLUME:	1.046 L	SCREEN LENGTH (L):	1.220 m
PL. (H-Ho):	0.533 m	TIME LAG (To):	1055 secs

RAULIC CONDUCTIVITY K= (r*r*ln(L/R))/(2*L*To): 6.0E-05 cm/sec

TIME (actual time)			WATER	DISPL.	%DISPL.
days	(HH:MM:SS)	TOTAL	DEPTH	H - h	(H-h)/
START TIME:	00:00:00	(sec.)	(h)		(H-Ho)
	00:00:11	11	4.150	0.340	0.638
	00:00:17	17	4.160	0.330	0.619
	00:00:31	31	4.165	0.325	0.610
	00:00:40	40	4.170	0.320	0.601
	00:00:55	55	4.180	0.310	0.582
	00:01:17	77	4.190	0.300	0.563
	00:01:39	99	4.200	0.290	0.544
	00:02:00	120	4.210	0.280	0.526
	00:03:00	180	4.230	0.260	0.488
	00:04:00	240	4.250	0.240	0.451
	00:05:00	300	4.265	0.225	0.422
	00:06:00	360	4.280	0.210	0.394
	00:07:00	420	4.290	0.200	0.375
	00:08:00	480	4.305	0.185	0.347
	00:09:00	540	4.315	0.175	0.329
	00:10:00	600	4.327	0.163	0.306
	00:11:00	660	4.335	0.155	0.291
	00:12:00	720	4.345	0.145	0.272
	00:13:30	810	4.355	0.135	0.253
	00:15:00	900	4.368	0.122	0.229
	00:16:30	990	4.378	0.112	0.210
	00:18:00	1080	4.383	0.107	0.201
	00:19:30	1170	4.393	0.097	0.182
	00:21:30	1290	4.400	0.090	0.169
	00:23:30	1410	4.410	0.080	0.150
	00:25:30	1530	4.420	0.070	0.131
	00:27:30	1650	4.425	0.065	0.122
	00:29:30	1770	4.430	0.060	0.113
	00:31:30	1890	4.437	0.053	0.099
	00:34:30	2070	4.442	0.048	0.090
	00:36:30	2190	4.450	0.040	0.075
	00:39:00	2340	4.452	0.038	0.071
	00:41:30	2490	4.455	0.035	0.066
	00:44:30	2670	4.460	0.030	0.056
	00:47:30	2850	4.465	0.025	0.047
	00:52:30	3150	4.475	0.015	0.028
	00:57:30	3450	4.482	0.008	0.015
	01:02:30	3750	4.482	0.008	0.015
	01:07:30	4050	4.482	0.008	0.015


SINGLE WELL RESPONSE TEST
(H - h) / (H - Ho) - Logarithmic
1.00
0.79
0.63
0.50
0.40
0.32
0.25
0.20
0.16
0.13
0.10
0.08
0.06
0.05
0.04
0.03
0.03
0.02
0.02
0.01
1
2
5
4
TIME (sec)
+ LINEAR FIT
CORRECTED FIT

PROJECT NO. 2467

PROJECT NAME CAMBRIDGE

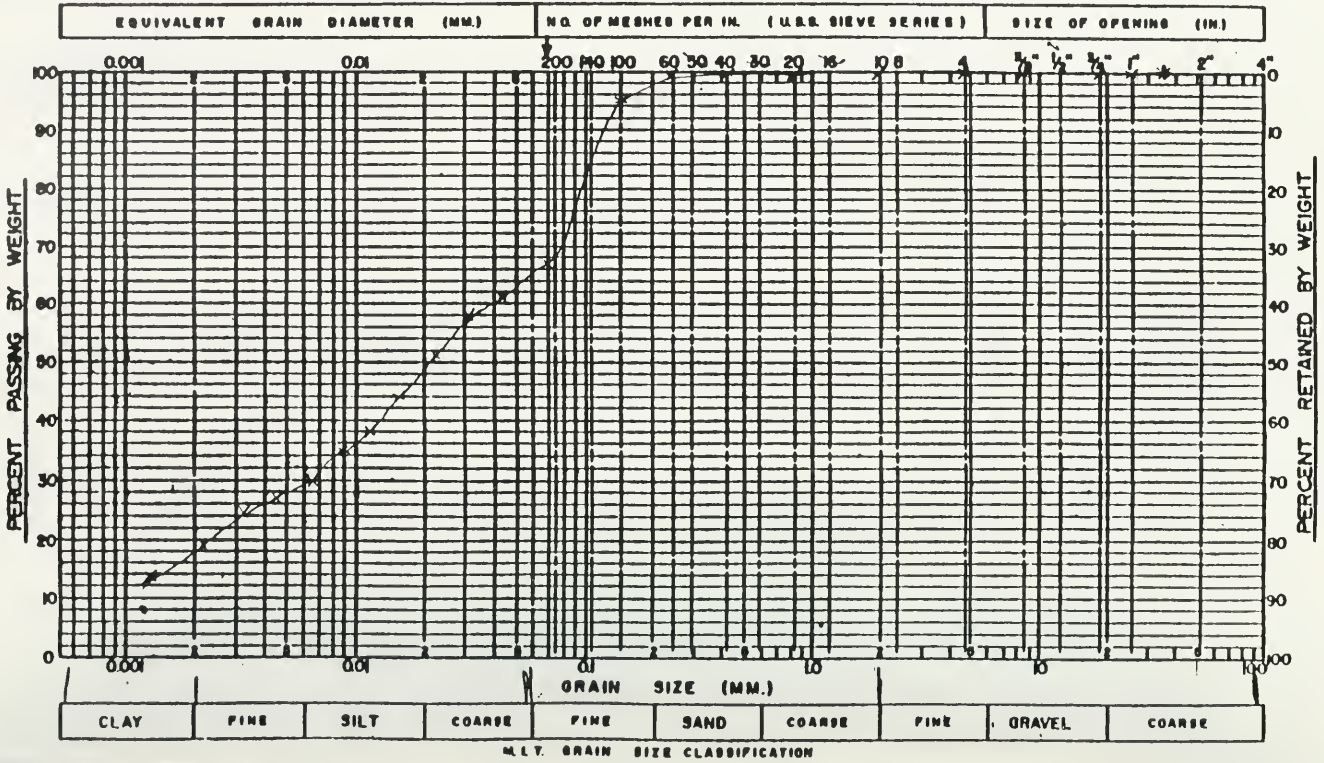
LOCATION Bull Run

DATE April 23 '67

SOIL DESCRIPTION

Depth 20 - 22 ft

TESTED BY



PROJECT NO. 2681

PROJECT NAME CAMBRIDGE

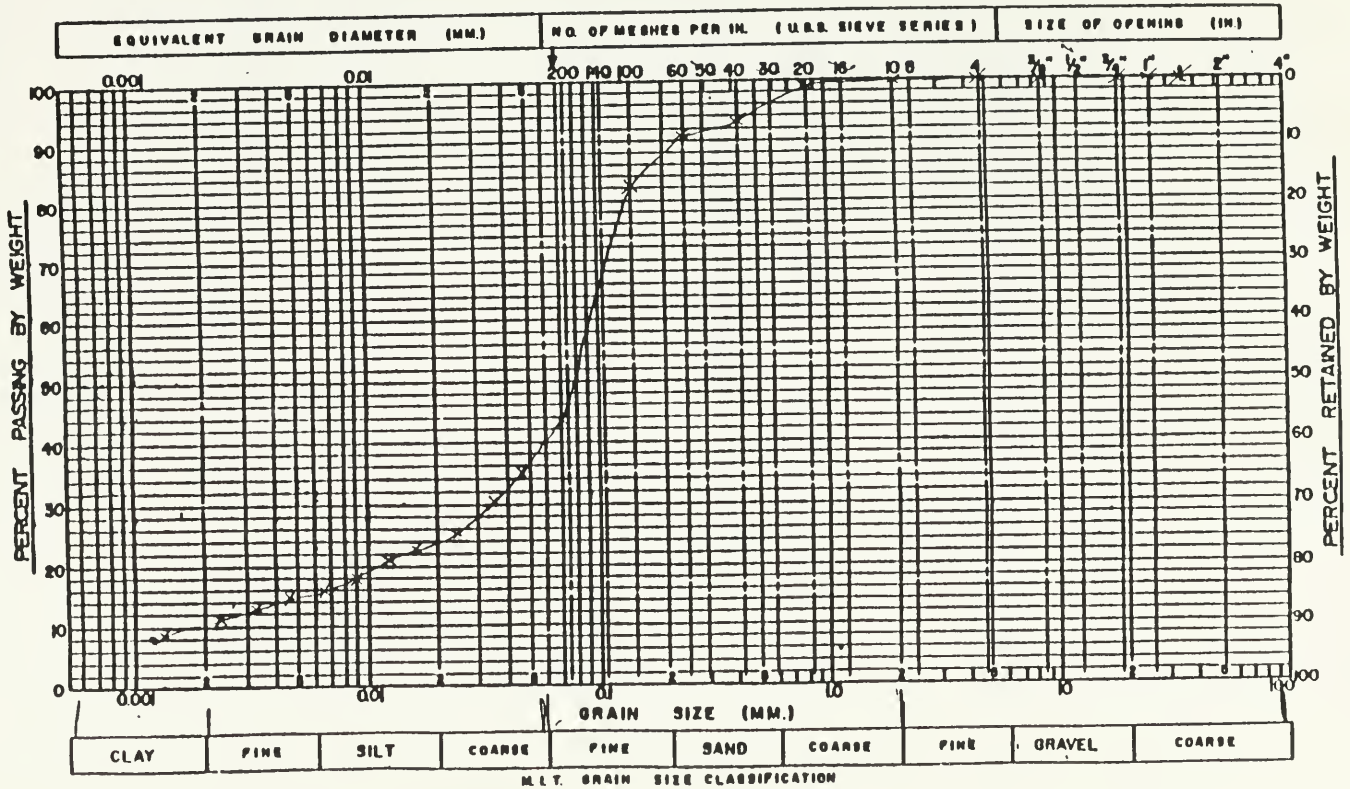
LOCATION BELL-87

DATE APRIL 21/87

GRAIN SIZE ANALYSIS
DATA SHEET

SOIL DESCRIPTION .....
Depth 15 ft

TESTED BY .....



APPENDIX E

ANALYTICAL REPORTS

TEL (514) 636-6218 631-1838
TELEX 05-822787 • (LYNJON)

DATE March 30, 1987

CLIENT ORDER # 2087

Attention: Ms. K. Kaufman

REPORT # NL-2402

RE Analysis of Soil Samples for Naphthalene and Benzo(a)Pyrene

Ms. Kaufman,

Two (2) soil samples, received March 19, 1987, were analysed for naphthalene and benzo(a)pyrene indicator PAH compounds by solvent extraction and gas chromatography with flame ionization detection. Results and detection limits are shown in the table below.

Table - Concentration of Indicator PAH Compounds in Soil Samples (µg/g)

Sample	Naphthalene	Benzo(a) Pyrene
BF 0016	2.38	<0.5
BF 0025	<0.05	<0.05

Chromatograms will be kept on file.

Sincerely,

NOVALAB LIMITED

B.E. Crowley, B.Sc.

Approved by J.D. Fenwich, Ph.D., P. Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

BEC/hl

TEL (514) 636-6218, 631-1838
TELEX 05-822787 • (LYNJON)

DATE May 19, 1987

CLIENT ORDER # 2087

REPORT # NL-2535

RE: Analysis of Soil for PAH
Analysis of Leachate for PAH

Ms. Kaufman,

Ten (10) soil samples were received April 28, 1987. Two (2) of these samples were analysed for polycyclic aromatic hydrocarbons by EPA method 625. All ten (10) soil samples were leached, according to the leaching procedure of Environment Quebec, and the resulting leachate was analysed also for PAH by EPA method 625.

Results and detection limits are shown in the appended tables.

Chromatograms will be kept on file. Results of gc/ms analyses are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

B.E. Crowley, B.Sc.

Approved by J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74.024
QUÉBEC

BEC/hl
encl.

CONCENTRATION OF PAH IN SOIL SAMPLES
ug/g

COMPOUND	2087 #1	MDL	2087 #2	MDL	Blank	MDL
ACENAPHTHENE	2230	30	-	3	-	0.3
ACENAPHTHYLENE	160	30	89.2	3	-	0.3
ANTHRACENE	1250	30	55.8	3	-	0.3
BENZ(A)ANTHRACENE	400	30	11.3	3	-	0.3
CHRYSENE	640	30	23.7	3	-	0.3
BENZO(B)FLUORANTHENE						
BENZO(K)FLUORANTHENE	420	50	TR	5		0.5
BENZO(A)PYRENE	530	50	TR	5	-	0.5
BENZO(GHI)PERYLENE	330	150	-	15	-	1.5
DIBENZ(A,H)ANTHRACENE	-	150	-	15	-	1.5
FLUORANTHENE	2400	30	112	3	-	0.3
FLUORENE	780	30	16.1	3	-	0.3
INDENO(1,2,3-cd)PYRENE	220	150	-	15	-	1.5
NAPHTHALENE	10300	30	180	3	-	0.3
PHENANTHRENE	5250	30	188	3	-	0.3
PYRENE	510	30	24.8	3	-	0.3

MDL = METHOD DETECTION LIMIT

Total concentration of benzo(b)- and benzo(k)fluoroanthene is shown in the row for benzo(b)fluoranthene.

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	2087 #1	2087 #2	Blank
D8-NAPHTHALENE			55.6
D10-ANTHRACENE			57.2
D10-FLUORANTHENE			60.8
D12-PERYLENE			100

CONCENTRATION OF PAH IN LEACHATE SAMPLES
ug/L

COMPOUND	2087 #1	2087 #5	MDL	2087 #2	MDL	2087 #3	2087 #4	2087 #6	2087 #7	MDL
ACENAPHTHENE	47.7	3.4	1	50.4	0.2	-	27.1	0.5	0.3	0.1
ACENAPHTHYLENE	283	355	1	2.7	0.2	-	0.4	-	-	0.1
ANTHRACENE	6.2	21	1	0.5	0.2	-	1	-	-	0.1
BENZ(A)ANTHRACENE+CHRYSENE	-	-	1	-	0.2	-	-	-	-	0.1
BENZO(B)FLUORANTHENE										0.1
BENZO(K)FLUORANTHENE	-	-	2	-	0.2	-	-	-	-	0.1
BENZO(A)PYRENE	-	-	2	-	0.2	-	-	-	-	0.1
BENZO(GHI)PERYLENE	-	-	5	-	0.4	-	-	-	-	0.2
DIBENZ(A,H)ANTHRACENE	-	-	5	-	0.4	-	-	-	-	0.2
FLUORANTHENE	3.5	5.6	1	-	0.2	-	0.2	-	-	0.1
FLUORENE	82	82	1	6.7	0.2	-	5.1	-	0.2	0.1
INDENO(1,2,3-cd)PYRENE	-	-	5	-	0.4	-	-	-	-	0.2
NAPHTHALENE	10550	777	1	240	0.2	-	0.3	1.4	1.6	0.1
PHENANTHRENE	117	160	1	6.6	0.2	-	6	-	0.4	0.1
PYRENE	5.7	6.1	1	-	0.2	-	0.5	-	-	0.1

MDL = METHOD DETECTION LIMIT

Total concentration of benzo(b)- and benzo(k)fluoroanthene is shown in the row for benzo(k)fluoranthene.

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	2087 #1	2087 #5	2087 #2	2087 #3	2087 #4	2087 #6	2087 #7
D8-NAPHTHALENE	94.4	63.5	52.2	62.2	50.6	63.5	56.7
D10-ANTHRACENE	81.4	63	87.4	76.7	85.7	77.9	83.2
D10-FLUORANTHENE	74.1	63.6	90.9	75.6	85	78.8	82.9
D12-PERYLENE	100	100	83.5	46.6	82.4	44.9	81.3

CONCENTRATION OF PAH IN LEACHATE SAMPLES
ug/L

COMPOUND	2087 #8	2087 #9	2087 #10	Leach. Blank	Lab Blank	MDL
ACENAPHTHENE	-	-	-	-	-	0.1
ACENAPHTHYLENE	-	-	-	-	-	0.1
ANTHRACENE	-	-	-	-	-	0.1
BENZ(A)ANTHRACENE + CHRYSENE	-	-	-	-	-	0.1
BENZO(B)FLUORANTHENE						
BENZO(K)FLUORANTHENE	-	-	-	-	-	0.1
BENZO(A)PYRENE	-	-	-	-	-	0.1
BENZO(GHI)PERYLENE	-	-	-	-	-	0.2
DIBENZ(A,H)ANTHRACENE	-	-	-	-	-	0.2
FLUORANTHENE	-	-	-	-	-	0.1
FLUORENE	-	-	-	-	-	0.1
INDENO(1,2,3-cd)PYRENE	-	-	-	-	-	0.2
NAPHTHALENE	-	-	-	-	-	0.1
PHENANTHRENE	-	0.2	-	-	-	0.1
PYRENE	-	-	-	-	-	0.1

MDL = METHOD DETECTION LIMIT

Total concentration of benzo(b)- and benzo(k)fluoroanthene is shown in the row for benzo(k)fluoranthene.

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	2087 #8	2087 #9	2087 #10	Leach. Blank	Lab Blank
D8-NAPHTHALENE	47.6	67	87.9	72.1	68.6
D10-ANTHRACENE	71.2	74.5	87.4	75.7	86.8
D10-FLUORANTHENE	80.4	82	90.4	93.2	87.1
D12-PERYLENE	87.3	45.5	59.1	44.5	92.9

CHAIN OF CUSTODY RECORD

PROJECT Nº. 2087

PROJECT NAME: MILL RACE (UNCONTAMINATED)

SAMPLER'S SIGNATURE Peter Hayes (SIGN)

SEQ. Nº.	SAMPLE Nº.	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
	#1	April 1/87			Soil	1	TOTAL & LEACH PAH
	#2					1	TOTAL & LEACH PAH
	#3					1	LEACH PAH
	#4					1	
	#5					1	
	#6					1	
	#7					1	
	#8					1	
	#9					1	
	#10					1	
				TOTAL Nº OF CONTAINERS		10	

RELINQUISHED BY: (1) (SIGN)	DATE/TIME	RECEIVED BY: (2) (SIGN)
RELINQUISHED BY: (2) (SIGN)	DATE/TIME	RECEIVED BY: (3) (SIGN)
RELINQUISHED BY: (3) (SIGN)	DATE/TIME	RECEIVED BY: (4) (SIGN)
RELINQUISHED BY: (4) (SIGN)	DATE/TIME	RECEIVED BY: (5) (SIGN)

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY (SIGN)	DATE/TIME

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GOLDEN ROD – CRA OFFICE COPY

002046

DATE May 19, 1987

CLIENT ORDER # 2087

REPORT # NL-2526

RE: Analysis of Water for PAH and Volatile Priority Pollutants

Ms. Kaufman,

One (1) sample of water, received May 1, 1987, was analysed for volatile priority pollutants by EPA method 624. One (1) sample of water, also received May 1, 1987, was analysed for polycyclic aromatic hydrocarbons by EPA method 625.

Results and detection limits are shown in the appended tables.

Chromatograms will be kept on file. Results of gc/ms are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

B.E. Crowley, B.Sc.

Approved by J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

BEC/hl

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	W-042987 PH-001	MDL
BENZENE	8940	1000
BROMODICHLOROMETHANE	-	100
BROMOFORM	-	500
BROMOMETHANE	-	100
CARBON TETRACHLORIDE	-	500
CHLOROBENZENE	-	100
CHLOROETHANE	-	100
2-CHLOROETHYL VINYL ETHER	-	5000
CHLOROFORM	-	100
CHLOROMETHANE	-	100
DIBROMOCHLOROMETHANE	-	100
1,2-DICHLOROBENZENE	-	150
1,3-DICHLOROBENZENE	-	
1,4-DICHLOROBENZENE	-	150
1,1-DICHLOROETHYLENE	-	100
1,1-DICHLOROETHANE	-	100
1,2-DICHLOROETHANE	-	100
TRANS-1,2-DICHLOROETHYLENE	-	100
DICHLOROMETHANE	-	5000
1,2-DICHLOROPROPANE	-	100
CIS-1,3-DICHLOROPROPENE	-	250
TRANS-1,3-DICHLOROPROPENE	-	100
ETHYLBENZENE	5000	50
A-METHYLSTYRENE	130	50
MESITYLENE	740	50
1,1,2,2-TETRACHLOROETHANE	-	1000
TETRACHLOROETHYLENE	-	100
TOLUENE	4190	500
1,1,1-TRICHLOROETHANE	-	100
1,1,2-TRICHLOROETHANE	-	250
TRICHLOROETHYLENE	-	100
TRICHLOROFLUOROMETHANE	-	500
M+P-XYLENE	1410	50
O-XYLENE	780	50
VINYL CHLORIDE	-	250
OTHER AROMATIC COMPOUNDS	-	50

MDL = METHOD DETECTION LIMITS

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

Total concentration of 1,3- and 1,4-dichlorobenzene is shown in the row for 1,4-dichlorobenzene.

CONCENTRATION OF PAH IN WATER SAMPLES
ug/L

COMPOUND	W-042987 PH-001	Lab Blank	MDL
ACENAPHTHENE	112	-	10
ACENAPHTHYLENE	19.3	-	10
ANTHRACENE	126	-	10
BENZ(A)ANTHRACENE	33.7	-	10
CHRYSENE	52.5	-	10
BENZO(B)FLUORANTHENE			
BENZO(K)FLUORANTHENE	41	-	20
BENZO(A)PYRENE	54.6	-	20
BENZO(GHI)PERYLENE	TR	-	50
DIBENZ(A,H)ANTHRACENE	-	-	50
FLUORANTHENE	239	-	10
FLUORENE	303	-	10
INDENO(1,2,3-cd)PYRENE	TR	-	50
NAPHTHALENE	8788	-	10
PHENANTHRENE	805	-	10
PYRENE	267	-	10

MDL = METHOD DETECTION LIMIT

Total concentration of benzo(b)- and benzo(k)fluoroanthene is shown in the row for benzo(k)fluoranthene.

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	W-042987 PH-001	Lab Blank
D8-NAPHTHALENE		62.8
D10-ANTHRACENE		68.8
D10-FLUORANTHENE		78.3
D12-PERYLENE		51.4

CHAIN OF CUSTODY RECORD

PROJECT NO. 2087

PROJECT NAME: MILL RACE CON.

SAMPLER'S SIGNATURE _____ (SIGN)

SEQ. NO.	SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	NO. OF CONTAINERS	REMARKS
	001	April 29			Water	2	PAH, UCC
	1 TRIP BLANK						
				TOTAL NO. OF CONTAINERS		2	

RELINQUISHED BY: (1) _____ (SIGN)	DATE/TIME: April 30 87	RECEIVED BY: (2) Wayne Smith (SIGN)
RELINQUISHED BY: (2) _____ (SIGN)	DATE/TIME: _____	RECEIVED BY: (3) _____ (SIGN)
RELINQUISHED BY: (3) _____ (SIGN)	DATE/TIME: _____	RECEIVED BY: (4) _____ (SIGN)
RELINQUISHED BY: (4) _____ (SIGN)	DATE/TIME: _____	RECEIVED BY: (5) _____ (SIGN)

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME: 5/1/87
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME: 5/1/87

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00[illegible]7

TEL (514) 636-6218 631-1838
FAX (514) 631-9814

DATE Jan. 27, 1989

CLIENT ORDER # 2087

REPORT # NL-4496

Attention: Ms. D. Hayes

RE Analysis of Water and Sediment for PAH - Project 2087

Ms. Hayes,

Two (2) water samples and three (3) sediment samples, received December 19, 1988, were analysed for polycyclic aromatic hydrocarbons by gc/ms equipped with a mass selective detector operated in the single ion monitoring mode (EPA method 625).

The water samples, identified as 2087 W-1 and 2087 W-2, were extracted on December 21, 1988 and analysed by gc/ms on December 24, 1988. The sediment samples, identified as 2087 S-1, 2087 S-2, and 2087 S-3, were extracted on December 23, 1988 and analysed by gc/ms on January 7, 1989.

The water samples contained only a very small amount of fine sediment, and this was allowed to settle out completely before the water for analysis was taken. The sediment samples were allowed to settle for four (4) days before the water portion was removed and the resulting sediment analysed (as discussed with Mr. Brian Crowley). The removed water was retained. One sample was also analysed in duplicate. Results and detection limits are shown in the attached Tables.

Chromatograms will be kept on file. Results are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

L.W. Tang, B.Sc. for J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74.024
QUEBEC

LWT/hl
encl.

CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL

ug/g

COMPOUND	2087 S-1	2087 S-2	DUPL. 2087 S-1	2087 S-3	BLANK	MDL
ACENAPETHENE	-	0.02	-	0.02	-	0.02
ACENAPETHYLENE	-	-	-	-	-	0.02
ANTERACENE	0.03	0.03	0.06	0.1	-	0.02
BENZ(A)ANTERACENE	0.3	0.1	0.3	0.2	-	0.02
BENZO(B)FLUORANTHENE]						
BENZO(K)FLUORANTHENE]	1.0	0.4	0.9	1.1	-	0.02
BENZO(A)PYRENE	0.5	0.1	0.4	0.7	-	0.02
BENZO(GHI)PERYLENE	0.2	0.1	0.3	0.4	-	0.04
CERYSENE	0.6	0.1	0.5	0.5	-	0.02
DIBENZ(A,H)ANTERACENE	0.09	TR	0.1	0.1	-	0.04
FLUORANTHENE .	0.6	0.4	0.6	0.9	-	0.02
FLUORENE	-	-	-	0.04	-	0.02
INDENO(1,2,3-CD)PYRENE	0.2	0.08	0.2	0.3	-	0.04
NAPHTHALENE	-	-	-	-	-	0.02
PHENANTERENE	0.3	0.2	0.2	0.5	-	0.02
PYRENE	0.6	0.4	0.6	0.8	-	0.02

MDL = METHOD DETECTION LIMIT

TR = TRACE

Total concentration of benzo(b)- and benzo(k)fluoranthene is shown in the row for benzo(k)fluoranthene.

RECOVERY OF SURROGATE STANDARDS

(%)

COMPOUND	2087 S-1	2087 S-2	DUPL. 2087 S-1	2087 S-3	BLANK
D8-NAPETHALENE	36.5	31.2	33.8	34.9	30.1
D10-ANTHERACENE	64.6	66.8	68.6	70.5	51.5
D10-FLUORANTHENE	79	75.8	77.4	78.4	74.3
D12-PERILENE	96.6	97.2	99.9	97.4	99.2

CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER
ug/L

COMPOUND	2087 W-1	2087 W-2	BLANK	MDL
ACENAPHTHENE	-	-	-	0.05
ACENAPHTYLENE	-	-	-	0.05
ANTHRACENE	-	-	-	0.05
BENZ(A)ANTHRACENE	-	-	-	0.05
BENZO(B)FLUORANTHENE]				
BENZO(K)FLUORANTHENE]	0.06	-	-	0.05
BENZO(A)PYRENE	-	-	-	0.05
BENZO(GHI)PERYLENE	-	-	-	0.1
CHRYSENE	-	-	-	0.05
DIBENZ(A,H)ANTHRACENE	-	-	-	0.1
FLUORANTHENE	0.06	-	-	0.05
FLUORENE	-	-	-	0.05
INDENO(1,2,3-CD)PYRENE	-	-	-	0.1
NAPETHALENE	-	-	-	0.05
PHENANTHRENE	-	-	-	0.05
PYRENE	-	-	-	0.05

MDL = METHOD DETECTION LIMIT

Total concentration of benzo(b)- and benzo(k)fluoranthene is shown in the row for benzo(k)fluoranthene.

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	2087 W-1	2087 W-2	BLANK
D8-NAPHTHALENE	54	41.6	32.4
D10-ANTHRACENE	59.4	57.4	54.3
D10-FLUORANTHENE	67.9	70.1	66.8
D12-PERYLENE	80.4	85.5	83.5

CHAIN OF CUSTODY RECORD

PROJECT №: 7

PROJECT NAME: K

SAMPLER'S SIGNATURE (SIGN)

SEQ. №	SAMPLE №	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
1	2-7-S-1	12	11			1	
	7-N-1	12	15			1	
	7-S-2	12	5			1	
	7-N-2	12	5			1	
5	7-S-3	12	15			1	
				TOTAL NUMBER OF CONTAINERS		5	

ANTICIPATED CHEMICAL HAZARDS: none

RELINQUISHED BY: [1] (SIGN)	DATE/TIME 12/17/96 11:30	RECEIVED BY: [2] (SIGN)
RELINQUISHED BY: [2] (SIGN)	DATE/TIME	RECEIVED BY: [3] (SIGN)
RELINQUISHED BY: [3] (SIGN)	DATE/TIME	RECEIVED BY: [4] (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: Fed Ex	SHIPPED BY: Fed Ex	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME

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GOLDEN ROD – SHIPPERS

14 Abacus Road
Brampton, Ontario
Canada L6T 5B7

Tel (416) 458-4044
Fax (416) 458-7303

Rec'd CRA

Page 1
Received: 02/13/90

Beak Analytical REPORT
03/05/90 13:03:33

Work Order # 90-02-108

MAR 1 4 1990

REPORT TO: Conestoga-Rovers & Associates
esi Colb, Drive
Waterloo, Ontario
N1V 1A2
ATTEN Graham Cheriau

PREPARED BY: Beak Analytical Services
14 Abacus Road
Brampton, Ontario
L6T 5B7
ATTEN Chester Lastoria
PHONE 416-458-4044

CERTIFIED BY:

CONTACT K. MCMILLAN

CLIENT CRA SAMPLES 2
COMPANY Conestoga-Rovers & Associates
FACILITY

Beak Analytical Services hereby disclaims any and all liability related to anomalous data arising from normal analytical and or sampling protocol. Should further information be required, please contact the Supervisor

WORK ID Project 2087 Millrace
TAKEN 02/12/90
TRANS
TYPE Soil
P.O. #
INVOICE Under separate cover

SAMPLE IDENTIFICATION

01 S-2087-KMV-001
02 S-2087-KMV-002

TEST CODES and NAMES used on this report

HEXCRS	Hexavalent Chromium
S01 ZN	Zinc
S02 CD	Cadmium
S04 CO	Cobalt
S05 CU	Copper
S07 PB	Lead
S08 CR	Chromium
S09 NI	Nickel
S10 BE	Beryllium
S11 MO	Molybdenum
S13 V	Vanadium
S16 BA	Barium
S20 HG	Mercury
S21 AS	Arsenic
S22 SE	Selenium
S23 AG	Silver
S25 SB	Antimony

2087
MONITORING DATA

14 Abacus Road
Brampton, Ontario
Canada L6T 5B7

Tel. (416) 458-4044
Fax (416) 458-7303

Conestoga-Rovers & Associates
651 Colby Drive
Waterloo, Ontario
N2V 1C2
Attn: Graham Chevreau

Date Received: 02/10/90
Date Reported: 02/05/90
Work Order: 90-02-108
Category:

Work ID: Project 2087 Millrace
P.O.#:

Test	Units	S-2087-KMV-001	S-2087-KMV-005
Hexavalent Chromium	ug/g	0.179	0.28
Zinc	ug/g	56	89/92
Cadmium	ug/g	0.10	0.30/0.40
Cobalt	ug/g	2.5	2.5/2.5
Copper	ug/g	13.5	14.5/12.5
Lead	ug/g	5.0	18.0/20.0
Chromium	ug/g	17	23/24
Nickel	ug/g	9	12 / 13
Beryllium	ug/g	<1	<1/<2
Molybdenum	ug/g	4	4 / 4
Vanadium	ug/g	14	24/27
Barium	ug/g	17	38/42
Mercury	ug/g	<0.02	<0.02
Arsenic	ug/g	<0.5	3.0/3
Selenium	ug/g	<0.5	<0.5/<1
Silver	ug/g	<0.5	<0.5/<1
Antimony	ug/g	<1	<1/<2

Certified By:

14 Abacus Road
Brampton, Ontario
Canada L6T 5B7

Tel: (416) 458-4044
Fax: (416) 458-7303

TEST CODE HEXCRS NAME Hexavalent Chromium

Diphenylcarbazide - Colorimetric
Reference: Ontario Ministry of the Environment. Handbook of Analytical Methods for Environmental Samples. 1983. No. CG1.

14 Abacus Road Tel: (416) 458-4044
Brampton, Ontario Fax: (416) 458-7303
Canada L6T 5B7

W.O. #90.02.108 QA/QC REPORT

PARAMETER	EXTRACTED DATE	ANALYSED DATE	ANALYTICAL BLANK	QA/QC
Cadmium	February 14, 1990	February 20, 1990	<0.0001 mg/L	BCSS-1
				True Value: 0.25
				Analyzed Value: 0.24
Cobalt	Not Applicable	February 26, 1990	<0.001 mg/L	BCSS-1
				True Value: 11.4
				Analyzed Value: 10.4
Copper	Not Applicable	February 20, 1990	-	WP 386
				True Value: 100
				Analyzed Value: 107
Lead	Not Applicable	February 21, 1990	<0.001 mg/L	WP386
				True Value: 22.7
				Analyzed Value: 21.2
Chromium	Not Applicable	February 28, 1990	<0.01 mg/L	WP386
				True Value: 123
				Analyzed Value: 58.5
Mercury	February 19, 1990	February 20, 1990	<0.05 ug/L	WP386
				True Value: 0.12
				Analyzed Value: 0.10
Arsenic	February 21, 1990	February 21, 1990	<1 ug/L	BCSS-1
				True Value: 11.1
				Analyzed Value: 9.5
Selenium	February 21, 1990	February 21, 1990	<1 ug/L	BCSS-1
				True Value: 0.43
				Analyzed Value: <0.5
Antimony	February 20, 1990	February 20, 1990	<2 ug/L	BCSS-1
				True Value: 0.59
				Analyzed Value: <1

14 Abacus Road
Brampton, Ontario
Canada L6T 5B7

Tel: (416) 458-4044
Fax: (416) 458-7303

W.O. #90.02.108

QA/QC REPORT (CONTINUED)

PARAMETER	EXTRACTED DATE	ANALYSED DATE	ANALYTICAL BLANK	QA/QC
Zinc	Not Applicable	February 19, 1990	0.02 mg/L	BCSS-1 True Value: 119 Analyzed Value: 115
Nickel	Not Applicable	February 19, 1990	<0.01 mg/L	BCSS-1 True Value: 55.3 Analyzed Value: 54.1
Beryllium	Not Applicable	February 21, 1990	<0.01 mg/L	BCSS-1 True Value: 1.3 Analyzed Value: 1.6
Molybdenum	Not Applicable	February 21, 1990	<0.01 mg/L	BCSS-1 True Value: - Analyzed Value: 5.4
Vanadium	Not Applicable	February 21, 1990	<0.01 mg/L	BCSS-1 True Value: 93.4 Analyzed Value: 49.8
Barium	Not Applicable	February 21, 1990	<0.01 mg/L	BCSS-1 True Value: - Analyzed Value: 56.6
Silver	Not Applicable	February 21, 1990	<0.01 mg/L	Municipal Sludge True Value: 80.6 Analyzed Value: 70.0

14 Abacus Road Tel (416) 458-4044
Brampton, Ontario Fax: (416) 458-7303
Canada L6T 5B7

W.O. #90.02.108 METHODS

Cadmium	Graphite Furnace
Cobalt	Graphite Furnace
Copper	Graphite Furnace
Lead	Graphite Furnace
Chromium	DCP
Mercury	Cold Vapour - Flameless Atomic Absorption (MOE 1983)
Arsenic	Hydride Generation
Selenium	Hydride Generation
Antimony	Graphite Furnace
Zinc	DCP
Nickel	DCP
Beryllium	DCP
Molybdenum	DCP
Vanadium	DCP
Barium	DCP
Silver	Graphite Furnace

Note: Beckman Instruments Inc.
Direct Current Plasma (DCP) Optional Emission Spoectrometric Method for Trace Elemental Analysis of Water and Wastes. Method AES 0029, 1984

TEL (514) 636-6218 631-1838
FAX (514) 631-9814

DATE March 7, 1990

CLIENT ORDER # 2087

REPORT # NL-6713

Attention: Mr. G. Chevreau

RE. Analysis of Soil Samples - Project Millrace

Sir,

Two (2) soil samples, received February 13, 1990, were extracted February 27, 1990 and analysed for polycyclic aromatic hydrocarbons by gas chromatography with flame ionization detection. Results are shown in the attached Table.

Chromatograms will be kept on file.

Regards,

NOVALAB LIMITED

E.E. Keirstead, B.Sc., Dipl.

Approved by J.D. Fenwick, Ph.D.,P.Chem.

CHIMISTE (1) John D. Fenwick 74-024 Ordre pfC

EEK/hl
encl.

CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL

ug/g

COMPOUND	S-2087 KMV-002	S-2087 KMV-006
NAPETHALENE	< 0.05	0.42
ACENAPHTHYLENE	< 0.05	0.05
ACENAPHTHENE	< 0.05	0.69
FLUORENE	< 0.05	0.32
PHENANTHRENE	< 0.05	1.2
ANTHRACENE	< 0.05	0.35
FLUORANTHENE	< 0.05	0.53
PYRENE	< 0.05	0.75
BENZ(A)ANTHRACENE	< 0.05	0.19
CHRYSENE	< 0.05	0.21
BENZO(B)FLUORANTHENE]		
BENZO(K)FLUORANTHENE]	< 0.12	0.24
BENZO(A)PYRENE	< 0.1	0.2
INDENO(1,2,3-CD)PYRENE]		
DIBENZ(A,H)ANTHRACENE]	< 0.25	< 0.25
BENZO(G,H,I)PERYLENE	< 0.2	< 0.2

MDL = METHOD DETECTION LIMIT

< = LESS THAN

Total concentration of benzo(b)- and benzo(k)fluoranthene is shown in the row for benzo(k)fluoranthene.

Total concentration of indeno(1,2,3-cd)pyrene and dibens(a,h)anthracene is shown in the row for dibenz(a,h)anthracene.

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2087

PROJECT NAME: MILLRACE

SAMPLER'S SIGNATURE _____ (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
C-2087-KMW-002		22-Sep-90			SOIL	1	PAH
							BY GC
C-2087-KMW-506		22-09-90			SOIL	1	PAH
				TOTAL NUMBER OF CONTAINERS		2	

ANTICIPATED CHEMICAL HAZARDS: PNA, TPH

RELINQUISHED BY: ① (SIGN)	DATE/TIME	RECEIVED BY: ② S. Dugway (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN) S. Dugway	DATE/TIME 13/01/91 10:20

WHITE – CRA OFFICE COPY
YELLOW – RECEIVING LABORATORY COPY
PINK – CRA LABORATORY COPY
GOLDEN ROD – SHIPPERS

Nº 009311

TEL. (514) 636-6218, 631-1838
FAX (514) 631-9814

Rec'd CRA

APR 0 2 1990

DATE: March 28, 1990

CLIENT ORDER #: 2087

REPORT #: NL-6896

Attention: Mr. G. Chevreau

RE: Analysis of Water Samples - Project Mill Race

Sir,

Four (4) water samples were received on February 26, 1990. Two (2) water samples were extracted on February 28, 1990 and analysed for polycyclic aromatic hydrocarbons by gas chromatography with flame ionization detection and the other two (2) samples were extracted on February 26, 1990 and analysed for volatile priority pollutants by gc/ms. Results and detection limits are shown in the attached Tables.

All data will remain on file.

Sincerely,

NOVALAB LIMITED

2087
MONITORING DATA

B.E. Crowley, B.Sc.

Approved by J.D. Fenwick, Ph.D.,P.Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

BEC/hl
encl.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER

ug/L

COMPOUND	W-2087 KMV-001	W-2087 KMV-005	BLANK	MDL
BENZENE	ND	ND	ND	1
BROMODICHLOROMETHANE	ND	ND	ND	1
BROMOFORM	ND	ND	ND	2
BROMOMETHANE	ND	ND	ND	10
CARBON TETRACHLORIDE	ND	ND	ND	2
CHLOROBENZENE	ND	ND	ND	1
CHLOROETHANE	ND	ND	ND	10
2-CHLOROETHYL VINYL ETHER	ND	ND	ND	10
CHLOROFORM	4.3	ND	ND	1
CHLOROMETHANE	ND	ND	ND	10
DIBROMOCHLOROMETHANE	ND	ND	ND	1
DIBROMOETHANE	ND	ND	ND	1
1,2-DICHLOROBENZENE	ND	ND	ND	1
1,3-DICHLOROBENZENE	ND	ND	ND	1
1,4-DICHLOROBENZENE	ND	ND	ND	1
1,1-DICHLOROETHYLENE	ND	ND	ND	1
1,1-DICHLOROETHANE	ND	ND	ND	1
1,2-DICHLOROETHANE	ND	ND	ND	2
TRANS-1,2-DICHLOROETHYLENE	ND	ND	ND	1
DICHLOROMETHANE	ND	ND	ND	5
1,2-DICHLOROPROPANE	ND	ND	ND	1
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	1
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	1
ETHYLBENZENE	1.1	ND	ND	1
A-METHYLSTRYENE	ND	ND	ND	1
METHYLSTYRENE ISOMERS	ND	ND	ND	1
MESITYLENE	ND	ND	ND	1
STYRENE	ND	ND	ND	2
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	2
TETRACHLOROETHYLENE	ND	ND	ND	1
TOLUENE	ND	ND	ND	2
1,1,1-TRICHLOROETHANE	ND	ND	ND	2
1,1,2-TRICHLOROETHANE	ND	ND	ND	1
TRICHLOROETHYLENE	ND	ND	ND	1
TRICHLOROFLUOROMETHANE	ND	ND	ND	2
M+P-XYLENE	TR	ND	ND	2
O-XYLENE	1.5	ND	ND	1
VINYL CHLORIDE	ND	ND	ND	5
OTHER AROMATIC COMPOUNDS	16	ND	ND	1

MDL = METHOD DETECTION LIMITS

ND = NOT DETECTED

TR = TRACE

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

CONCENTRATION OF POLICYCLIC AROMATIC HYDROCARBONS IN WATER

ug/L

COMPOUND	W-2087 KMV-002	W-2087 KMV-006*	MDL
NAPHTHALENE	ND	ND	1
ACENAPHTHYLENE	ND	ND	1
ACENAPHTHENE	ND	ND	1
FLUORENE	ND	ND	1
PHENANTHRENE	ND	ND	1
ANTHRACENE	ND	ND	1
FLUORANTHENE	ND	ND	1
PYRENE	ND	ND	1
BENZ(A)ANTHRACENE	ND	ND	1
CHRYSENE	ND	ND	1
BENZO(B)FLUORANTHENE	ND	ND	1
BENZO(K)FLUORANTHENE	ND	ND	1
BENZO(A)PYRENE	ND	ND	1
INDENO(1,2,3-CD)PYRENE]			
DIBENZ(A,H)ANTHRACENE]	ND	ND	3
BENZO(G,H,I)PERYLENE	ND	ND	2.5

MDL = METHOD DETECTION LIMIT

ND = Not Detected

Total concentration of indeno(1,2,3-cd)pyrene and dibens(a,h)anthracene is shown in the row for dibenz(a,h)anthracene.

CHAIN OF CUSTODY RECORD

PROJECT №: 2087

PROJECT NAME: Mill Race

SAMPLER'S SIGNATURE: K. Vander Meulen (SIGN)

SEQ. №	SAMPLE №	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
	W-2087-KMV-001			well	water	1	VOC
	"	-002		"	"	1	PAH
	"	-003		"	"	1	VOC
	W-2087-KMV-006			well	water	1	PAH
				TOTAL NUMBER OF CONTAINERS		4	

ANTICIPATED CHEMICAL HAZARDS: coal tar

RELINQUISHED BY: [1] K. Vander Meulen (SIGN)	DATE/TIME: 2/23/90 13:30	RECEIVED BY: [2] S. Dingman (SIGN)
RELINQUISHED BY: [2] (SIGN)	DATE/TIME: /	RECEIVED BY: [3] (SIGN)
RELINQUISHED BY: [3] (SIGN)	DATE/TIME: /	RECEIVED BY: [4] (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
Courier	FED. EX.		/

CONDITION OF SEAL UPON RECEIPT:

GENERAL CONDITION OF COOLER: GOOD

COOLER OPENED BY: (SIGN) S. Dingman DATE/TIME 2/24/90 11:45

WHITE – CRA OFFICE COPY
YELLOW – RECEIVING LABORATORY COPY
PINK – CRA LABORATORY COPY
GOLDEN ROD – SHIPPERS

№ 007517

TEL. (514) 636-6218, 631-1838
FAX (514) 631-9814

DATE: May 31, 1990

CLIENT ORDER # 2087

REPORT # NL-7287

Attention: Mr. G. Chevreau

RE: Analysis of Water Samples - Project : 2087

Sir,

Two (2) water samples, received May 4, 1990, were extracted May 10,1990 and analysed for polycyclic aromatic hydrocarbons by gas chromatography with flame ionization detection (EPA 610). Results are shown in the attached Table.

Chromatograms will be kept on file.

Regards,

NOVALAB LIMITED

B.B.Crowley, B.Sc.

Approved by J.D. Fenwick, Ph.D.,P.Chem.

CHIMISTE
John D. Fenwick
74-026
QUEBEC

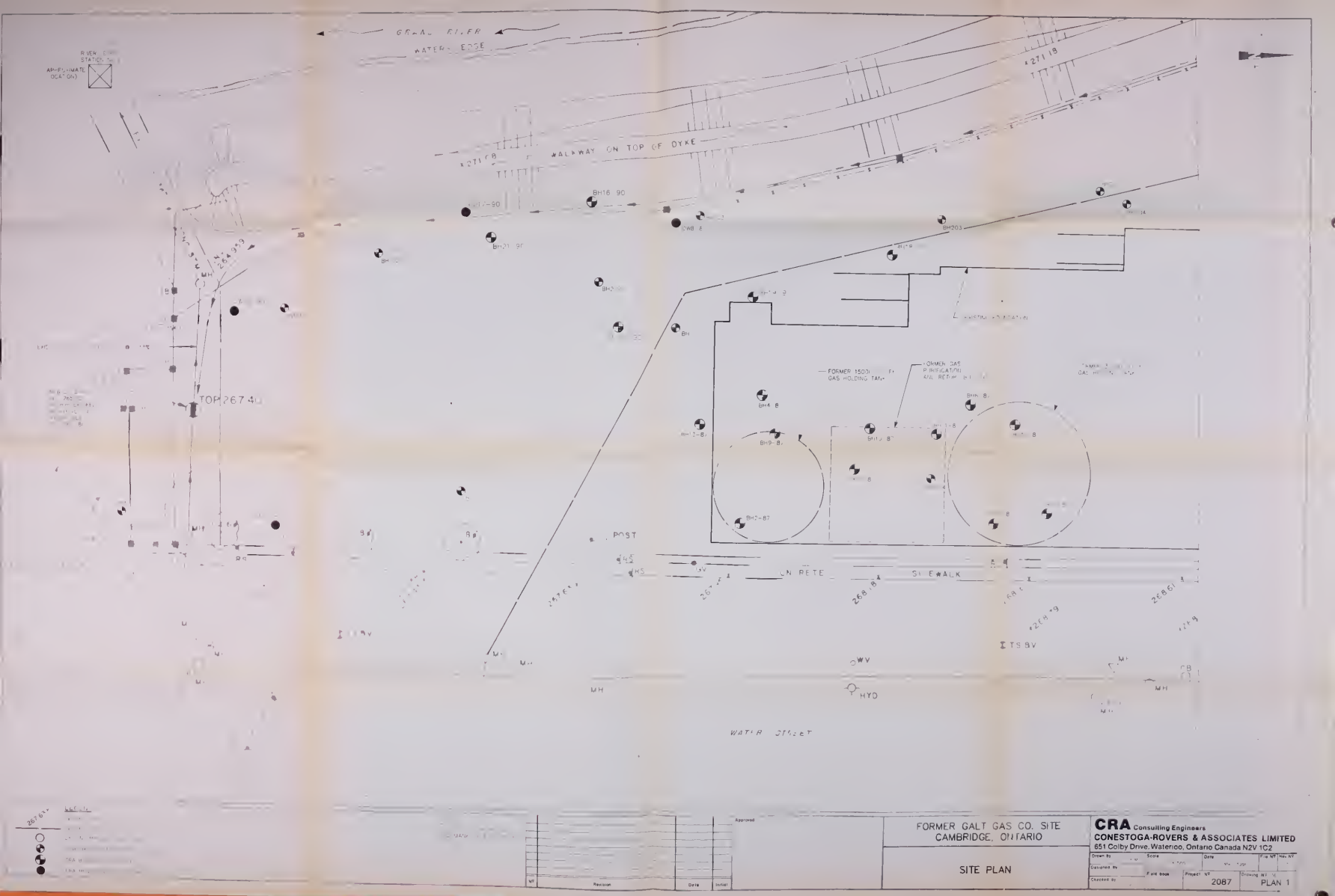
BEC/er
encl.

CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER
ug/L

COMPOUND	W-3 03/05/90	W-4 03/05/90	MDL
NAPETHALENE	-	-	1.2
ACENAPETHYLENE	-	-	1.5
ACENAPETHENE	-	-	1.2
FLUORENE	-	-	1.5
PHENANTHRENE	-	-	2
ANTHRACENE	-	-	2
FLUORANTHENE	-	-	2
PYRENE	-	-	1.5
BENZ(A)ANTHRACENE	-	-	2
CHRYSENE	-	-	2
BENZO(B+K)FLUORANTHENE	-	-	4
BENZO(A)PYRENE	-	-	3
INDENO(1,2,3-CD)PYRENE)	-	-	8
DIBENZ(A,H)ANTHRACENE)			
BENZO(GHI)PERYLENE	-	-	5

MDL = METHOD DETECTION LIMIT

Total concentration of indeno (1,2,3-CD)pyrene and dibenz(A,H)anthracene is shown in the row of indeno (1,2,3-CD) pyrene.



FORMER GALT GAS CO. SITE
CAMBRIDGE, ONTARIO

SITE PLAN

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn By	Scale	Date	File No.	Rev. No.
Calculated By				
Checked By	Field Book	Project No. 2087	Drawing No. PLAN 1	

Approved

No.	Revision	Date	Initial